PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-046369
(43)Date of publication of application : 14.02.2003

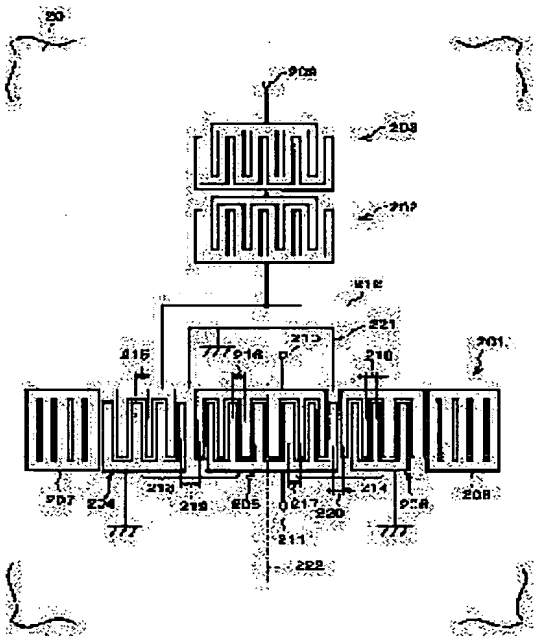
(51)Int.Cl. H03H 9/64
H03H 9/25

(21)Application number : 2001-228673
(22)Date of filing : 27.07.2001

(71)Applicant : MURATA MFG CO LTD
(72)Inventor : TAKAMINE YUICHI

(54) SURFACE ACOUSTIC WAVE FILTER AND COMMUNICATION DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a surface acoustic wave filter that enhances the balance between balanced signal terminals 210 and 211 and to provide a communication device.
SOLUTION: The surface acoustic wave filter is provided with IDTs(Inter- Digital Transducers) 204, 205 and 206 placed along the propagation direction of a surface acoustic wave. The balanced signal terminals 210 and 211 are connected to the IDT 205. The IDTs 204, 205 and 206 are placed so as to be horizontally asymmetric with respect to a virtual axis assumed perpendicularly to the propagation direction in the middle of the propagation direction of the surface acoustic wave in each of the IDTs 204, 205 and 206.



LEGAL STATUS

[Date of request for examination] 04.03.2003
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

(19)日本国特許庁(JP)　(12)公開特許公報（A）　(11)特許出願公開番号

特開２００３－４６３６９

（Ｐ２００３－４６３６９Ａ）

(43)公開日　平成15年2月14日(2003.2.14)

(51)Int.Cl.⁷	識別記号	FI		テーマコード(参考)
Ｈ０３Ｈ　9/64		Ｈ０３Ｈ　9/64	Ｚ	5J097
9/25		9/25	Ｚ	

審査請求　未請求　請求項の数８　ＯＬ　（全１７頁）

(21)出願番号　特願2001-228673(P2001-228673)

(22)出願日　平成13年7月27日(2001.7.27)

(71)出願人　000006231
株式会社村田製作所
京都府長岡京市天神二丁目26番10号

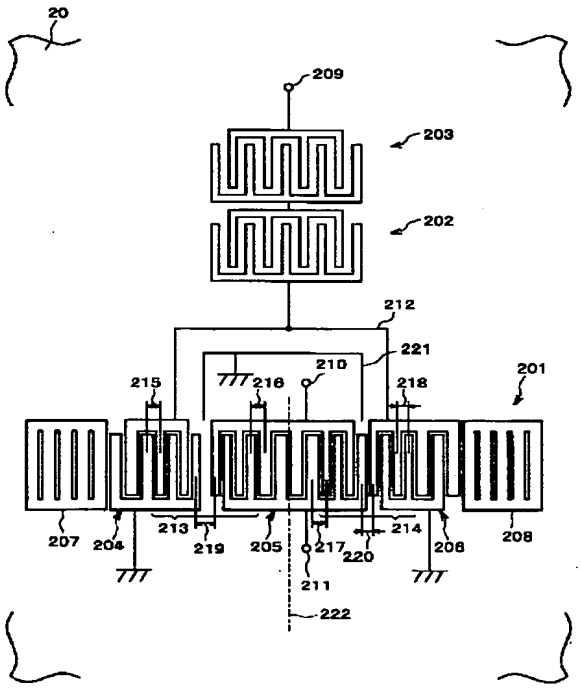
(72)発明者　高峰　裕一
京都府長岡京市天神二丁目26番10号　株式会社村田製作所内

(74)代理人　100080034
弁理士　原　謙三

Ｆターム(参考)　5J097 AA13 BB11 DD04 DD05 DD13 DD20 GG03 GG04

(54)【発明の名称】弾性表面波フィルタ、通信装置

(57)【要約】
【課題】　各平衡信号端子２１０、２１１間の平衡度を改善した弾性表面波フィルタ及び通信装置を提供する。
【解決手段】　各ＩＤＴ２０４、２０５、２０６を、弾性表面波の伝搬方向に沿って設ける。フロートバランスタイプとなるように、各平衡信号端子２１０、２１１をＩＤＴ２０５にそれぞれ接続して設ける。各ＩＤＴ２０４、２０５、２０６における、弾性表面波の伝搬方向の中央部であって、上記伝搬方向に対し垂直に想定した仮想軸２２２に対して左右非対称となるように各ＩＤＴ２０４、２０５、２０６を設定する。



1

【特許請求の範囲】

【請求項１】圧電基板上に、入力電気信号を弾性表面波に変換して出力し、伝搬してくる弾性表面波を出力電気信号に変換して出力するくし型電極部を弾性表面波の伝搬方向に沿って複数有するくし型電極部連設体が設けられ、

くし型電極部連設体に接続される平衡信号端子が設けられ、

くし型電極部連設体は、くし型電極部連設体における弾性表面波の伝搬方向の中央部であって、上記伝搬方向に対して垂直となる仮想軸を挟んで非対称であることを特徴とする弾性表面波フィルタ。

【請求項２】請求項１記載の弾性表面波フィルタにおいて、

前記くし型電極部連設体は、奇数個のくし型電極部を有し、

前記仮想軸は、複数あるくし型電極部のうち中央に位置するくし型電極部の中心部に弾性表面波の伝搬方向に対して垂直に設定されていることを特徴とする弾性表面波フィルタ。

【請求項３】請求項１または２記載の弾性表面波フィルタにおいて、

前記くし型電極部連設体の互いに隣り合うくし型電極部同士の距離が、前記仮想軸を挟んで非対称である箇所を有することを特徴とする弾性表面波フィルタ。

【請求項４】請求項１ないし３の何れかに記載の弾性表面波フィルタにおいて、

前記くし型電極部連設体のピッチに対する電極指幅の比が、前記仮想軸を挟んで非対称である箇所を有することを特徴とする弾性表面波フィルタ。

【請求項５】請求項１ないし４の何れかに記載の弾性表面波フィルタにおいて、

前記くし型電極部連設体のピッチが、前記仮想軸を挟んで非対称である箇所を有することを特徴とする弾性表面波フィルタ。

【請求項６】請求項１ないし５の何れかに記載の弾性表面波フィルタにおいて、

前記くし型電極部連設体は２つのくし型電極部が互いに隣り合う箇所に周囲の電極指よりピッチの小さい電極指を数本設けた狭ピッチ電極指部を有し、

上記狭ピッチ電極指部のピッチが、前記仮想軸を挟んで非対称である箇所を有することを特徴とする弾性表面波フィルタ。

【請求項７】請求項１ないし６の何れかに記載の弾性表面波フィルタにおいて、

前記くし型電極部連設体に対し、直列及び並列の少なくとも一方にて、弾性表面波共振子が少なくとも１つ接続されていることを特徴とする弾性表面波フィルタ。

【請求項８】請求項１ないし７の何れかに記載の弾性表面波フィルタを有することを特徴とする通信装置。

2

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、フィルタ特性を有すると共に、特に平衡－不平衡変換機能を有する弾性表面波フィルタ、及びそれを用いた通信装置に関するものである。

【０００２】

【従来の技術】従来、近年の携帯電話機の小型化、軽量化に対する技術的進歩は目覚しいものがある。これを実現するための手段として、各構成部品の削減、小型化はもとより、複数の機能を複合した部品の開発も進んできた。このような状況を背景に、携帯電話機のＲＦ段に使用する弾性表面波フィルタに平衡－不平衡変換機能、いわゆるバラン（balun)の機能を有するものも近年盛んに研究され、ＧＳＭ方式（Global System for Mobile communications)などを中心に使用されるようになってきた。

【０００３】バランとは、平行二線式フィーダのような平衡線路と同軸ケーブルのような不平衡線路とを直接接続すると、不平衡電流が流れ給電線（フィーダ）自体がアンテナとして動作してしまい望ましくないので、不平衡電流を阻止し、平衡線路と不平衡線路とを整合する回路をいう。

【０００４】このような平衡－不平衡変換機能を備えた弾性表面波フィルタに関する特許も、幾つか出願されている。入力インピーダンスと出力インピーダンスがほぼ等しい、平衡－不平衡変換機能を備えた弾性表面波フィルタとしては、図１９に示すような構成が広く知られている。

【０００５】図１９に示す弾性表面波フィルタでは、圧電基板１００上に、くし型電極部（すだれ状電極とも呼ばれ、Inter-Digital Transducer、以下、ＩＤＴという）１０１が設けられ、そのＩＤＴ１０１の左右（弾性表面波の伝搬方向に沿った）に各ＩＤＴ１０２、１０３が配置されている。

【０００６】さらに、上記弾性表面波フィルタにおいては、これらの各ＩＤＴ１０１、１０２、１０３を左右から挟み込むように、弾性表面波を反射して変換効率を向上させるための各リフレクタ１０４、１０５がそれぞれ配置されており、また、各平衡信号端子１０６、１０７、及び不平衡信号端子１０８が設けられている。

【０００７】このような弾性表面波フィルタは、３ＩＤＴタイプの縦結合共振子型弾性表面波フィルタと呼ばれ、各ＩＤＴ１０１、１０２、１０３間での弾性表面波を用いた変換により平衡－不平衡変換機能を有するものである。

【０００８】平衡－不平衡変換機能を有する弾性表面波フィルタでは、不平衡信号端子と平衡信号端子のそれぞれの端子との間の通過帯域内での伝送特性において、振幅特性が等しく、かつ位相が１８０度反転していること

が要求され、それぞれ平衡信号端子間の振幅平衡度及び位相平衡度と呼んでいる。

【０００９】振幅平衡度及び位相平衡度は、前記平衡－不平衡変換機能を有する弾性表面波フィルタを３ポートのデバイスと考え、例えば不平衡入力端子を第一ポート、平衡出力端子のそれぞれを第二ポート、第三ポートとしたとき、振幅平衡度＝〔Ａ〕、Ａ≒｜２０ｌｏｇ（Ｓ２１）｜－｜２０ｌｏｇ（Ｓ３１）｜、位相平衡度＝Ｂ－１８０、Ｂ＝｜∠Ｓ２１－∠Ｓ３１｜にてそれぞれ定義される。なお、Ｓ２１は第一ポートから第二ポートへの伝達係数を、Ｓ３１は第一ポートから第三ポートへの伝達係数を示しており、また、上記各式中の｜｜は絶対値を示すためのものである。

【００１０】このような平衡信号端子間の平衡度については、理想的には弾性表面波フィルタの通過帯域内で振幅平衡度が０ｄＢ、位相平衡度が０度とされている。

【００１１】

【発明が解決しようとする課題】しかしながら、図１９に示す従来の構成においては、平衡信号端子間の平衡度が劣化するという問題があった。その理由は幾つか考えられるが、平衡信号端子１０６に接続されている電極指とＩＤＴ１０２のシグナル電極指の距離（図２１の１０９）と、平衡信号端子１０７に接続されている電極指とＩＤＴ１０３のシグナル電極指の距離（図２１の１１０）とが、電極指のピッチで決まる波長の０．５倍異なることが挙げられる。

【００１２】これにより平衡信号端子１０６と１０７それぞれに接続されている電極指の総容量が異なる、電気と弾性表面波の変換効率が異なるといった弊害が発生し、結果、平衡度の悪化につながっていた。図２０のように図１９の平衡信号端子１０７をアースに接続して平衡信号端子１０６から出力される周波数に対する振幅特性と、図２１のように平衡信号端子１０６をアースに接続して平衡信号端子１０７から出力される振幅特性の差を図２２に示す。２つの振幅特性は大きく異なっており、この差が平衡度の悪化につながっている。

【００１３】本発明の目的は、平衡信号端子間の平衡度悪化の一因である上記の平衡信号端子間の差を是正することで、平衡信号端子間の平衡度が良好な、平衡－不平衡変換機能を有する弾性表面波フィルタ及びそれを用いた通信装置を提供することにある。

【００１４】

【課題を解決するための手段】本発明の弾性表面波フィルタは、以上の課題を解決するために、圧電基板上に、入力電気信号を弾性表面波に変換して出力し、伝搬してくる弾性表面波を出力電気信号に変換して出力するＩＤＴを弾性表面波の伝搬方向に沿って複数有するＩＤＴ連設体が設けられ、ＩＤＴ連設体に接続される平衡信号端子が設けられ、ＩＤＴ連設体は、ＩＤＴ連設体における弾性表面波の伝搬方向の中央部であって、上記伝搬方向に対して垂直となる仮想軸を挟んで非対称であることを特徴としている。上記平衡信号端子はフロートバランスタイプ（電気的中性点を有さないタイプ）が好ましい。

【００１５】上記弾性表面波フィルタにおいては、前記ＩＤＴ連設体は、奇数個のＩＤＴを有し、前記仮想軸は、複数あるＩＤＴのうち中央に位置するＩＤＴの中心部に弾性表面波の伝搬方向に対して垂直に設定されていてもよい。

【００１６】上記弾性表面波フィルタでは、前記ＩＤＴ連設体の互いに隣り合うＩＤＴ同士の距離が、前記仮想軸を挟んで非対称である箇所を有していてもよい。

【００１７】上記弾性表面波フィルタにおいては、前記ＩＤＴ連設体のピッチに対する電極指幅の比（ｄｕｔｙ）が、前記仮想軸を挟んで非対称である箇所を有していてもよい。

【００１８】上記弾性表面波フィルタでは、前記ＩＤＴ連設体のピッチが、前記仮想軸を挟んで非対称である箇所を有していてもよい。

【００１９】上記弾性表面波フィルタにおいては、前記ＩＤＴ連設体は２つのＩＤＴが互いに隣り合う箇所に周囲の電極指よりピッチの小さい電極指を数本設けた狭ピッチ電極指部を有し、上記狭ピッチ電極指部のピッチが、前記仮想軸を挟んで非対称である箇所を有していてもよい。

【００２０】上記構成によれば、ＩＤＴを弾性表面波の伝搬方向に沿って複数有するＩＤＴ連設体を設けたので、特定の周波数帯域を通過させ、それ以外を抑制するフィルタ機能を発揮できる。

【００２１】また、上記構成では、ＩＤＴ連設体に接続される平衡信号端子をフロートバランスタイプ（電気的中性点を有さないタイプ）にて設けたので、平衡－不平衡変換機能を発揮できると共に、ＩＤＴ連設体における弾性表面波の伝搬方向の中央部であって、かつ、上記伝搬方向に対して垂直となる仮想軸を比較的容易に設定することが可能となる。

【００２２】そして、上記構成においては、ＩＤＴ連設体を、上記仮想軸を挟んで非対称、例えば、互いに隣り合うＩＤＴ同士の距離が、前記仮想軸を挟んで非対称、または、ＩＤＴ連設体のｄｕｔｙが、前記仮想軸を挟んで非対称、または、ＩＤＴ連設体に設けた狭ピッチ電極指部を、前記仮想軸を挟んで非対称に設定することで、平衡度、特に位相平衡度を改善できる。

【００２３】これらにより、上記構造は、フィルタ機能を発揮できると共に、平衡度、特に位相平衡度が改善された平衡－不平衡変換機能を発揮できて、携帯電話等の通信装置に好適に適用できる。

【００２４】上記弾性表面波フィルタでは、前記ＩＤＴ連設体に対し、直列及び並列の少なくとも一方にて、弾性表面波共振子が少なくとも１つ接続されていることが好ましい。上記構成によれば、弾性表面波共振子をさら

に接続したことにより、フィルタ機能を向上できる。

【００２５】本発明の通信装置は、前記の課題を解決するために、上記の何れかに記載の弾性表面波フィルタを有することを特徴としている。上記構成によれば、フィルタ機能を発揮できると共に、平衡度、特に位相平衡度が改善された平衡－不平衡変換機能を発揮できる弾性表面波フィルタを用いたので、通信機能を向上できる。

【００２６】

【発明の実施の形態】本発明の実施の各形態について図１ないし図１９に基づいて説明すれば、以下の通りである。

【００２７】（実施の第一形態）本発明に係る実施の第一形態の弾性表面波フィルタは、図１に示すように、圧電基板２０上において、縦結合共振子型の、弾性表面波フィルタ部（ＩＤＴ連設体）２０１と、上記弾性表面波フィルタ部２０１に対し、直列接続された弾性表面波共振子２０２と弾性表面波共振子２０３とがフォトリソグラフィー法等により形成されたアルミニウム（Ａｌ）電極（箔）により形成されている。圧電基板２０の素材としては、４０±５°ＹｃｕｔＸ伝搬$LiTaO_3$が挙げられる。以後の実施の各形態の弾性表面波フィルタでは、ＰＣＳ(Personal CommunicationSystem) 受信用の弾性表面波フィルタを例にとって説明している。

【００２８】弾性表面波フィルタ部２０１では、ＩＤＴ２０５を弾性表面波の伝搬方向に沿って左右から挟み込むように各ＩＤＴ２０４、２０６が形成され、それらの両側に各リフレクタ２０７、２０８が形成されている。

【００２９】ＩＤＴは、帯状の基端部（バスバー）と、その基端部の一方の側部から直交する方向に延びる複数の、互いに平行な帯状の電極指とを備えた電極指部を２つ備えており、上記各電極指部の電極指の側部を互いに対面するように互いの電極指間に入り組んだ状態にて上記各電極指部を有するものである。

【００３０】よって、ＩＤＴでは、２つの電極指部に対し各基端部（バスバー）を介して入力電気信号に基づく電位差が生じると、その部分の圧電基板２０の表面上に弾性表面波が発生し、その弾性表面波は各電極指の幅方向（各電極指の長手方向に対し直交する方向）の双方向に圧電基板２０の表面上を伝搬する。一方、電気信号が入力されていないＩＤＴでは、伝搬してきた弾性表面波により圧電基板２０の表面上に発生した電位差を各電極指によって検出し、出力電気信号に変換して出力できる。

【００３１】このようなＩＤＴでは、各電極指の長さや幅、隣り合う各電極指の間隔、互いの電極指間での入り組んだ状態の対面長さを示す交叉幅を、それぞれ設定することにより信号変換特性や、通過帯域の設定が可能となっている。上記各リフレクタは、伝搬してきた弾性表面波を反射するためのものである。

【００３２】さらに、弾性表面波フィルタ部２０１においては、図１を見るとわかるように、互いに隣り合うＩＤＴ２０４とＩＤＴ２０５との対向部分の数本の電極指（狭ピッチ電極指）のピッチを、ＩＤＴ２０４及びＩＤＴ２０５の他の部分の電極指よりも小さくしている（図１の２１３の箇所）。同様に、互いに隣り合うＩＤＴ２０５とＩＤＴ２０６との対向部分の数本の電極指（狭ピッチ電極指）のピッチを、ＩＤＴ２０５及びＩＤＴ２０６の他の部分の電極指よりも小さくしている（図１の２１４の箇所）。これにより、弾性表面波フィルタ部２０１では、挿入損失を低減できる。

【００３３】また、各平衡信号端子２１０、２１１が、中央のＩＤＴ２０５の各電極指部に対しそれぞれ接続されて設けられている。これにより、弾性表面波フィルタ部２０１は、アース電位を電気的中性点として有さない、フロートバランスタイプとなっている。不平衡信号端子２０９が、ＩＤＴ２０４とＩＤＴ２０６の一方の電極指部に対しそれぞれ接続されて設けられている。ＩＤＴ２０４とＩＤＴ２０６の他方の電極指部はアースに接続されている。

【００３４】このように各平衡信号端子２１０、２１１及び不平衡信号端子２０９を接続することで、弾性表面波フィルタ部２０１においては、平衡－不平衡変換機能を備えることが可能となる。つまり、各平衡信号端子２１０、２１１に、平衡電気信号が入力されると、不平衡信号端子２０９から不平衡電気信号が出力される一方、不平衡信号端子２０９に不平衡電気信号が入力されると、各平衡信号端子２１０、２１１から平衡電気信号が出力されることになる。

【００３５】前述の弾性表面波共振子２０２と弾性表面波共振子２０３は、シグナルライン２１２を介して、不平衡信号端子２０９と各ＩＤＴ２０４、２０６との間に直列接続されている。ちなみに図１では図を簡潔にするために電極指の本数を実際より少なく示している。

【００３６】さらに、アースライン２２１が、シグナルライン２１２と平衡信号端子２１０の間に、上記両者間に橋絡的に入る容量を低減するためのシールドパターンとして設けられている。

【００３７】そして、実施の第一形態の弾性表面波フィルタでは、弾性表面波の伝搬方向にて互いに隣り合うＩＤＴ２０４及びＩＤＴ２０５の間隔と、やはり弾性表面波の伝搬方向にて互いに隣り合うＩＤＴ２０５及びＩＤＴ２０６の間隔が互いに異なるように各ＩＤＴ２０４、２０５、２０６は設定されている。すなわち、実施の第一形態の弾性表面波フィルタにおいては、弾性表面波フィルタ部２０１の中央部にあるＩＤＴ２０５における、弾性表面波の伝搬方向の中心部であって、かつ、弾性表面波の伝搬方向に対して垂直に仮想軸２２２を想定した場合、この仮想軸２２２を挟んで左右非対称な構造となっていることになる。

【００３８】縦結合共振子型の弾性表面波フィルタ部２

０１の詳細な設計は、狭ピッチ電極指のピッチで決まる波長をλI_2（図１の２１３、２１４の箇所）、その他の電極指のピッチで決まる波長をλI_1とすると、
交叉幅Ｗ：６０．６λI_1
ＩＤＴ本数（２０４、２０５、２０６の順）：２９（４）／（４）４５（４）／（４）２９本（カッコ内はピッチを小さくした電極指の本数）
ＩＤＴ波長λI_1：２．０６μm、λI_2：１．８８μm
リフレクタ波長λR：２．０７μm
リフレクタ本数：１００本
ＩＤＴ－ＩＤＴ間隔：０．５００λI_2（図１の２１９）、０．４８４λI_2（図１の２２０）
波長λI_1と波長λI_2の電極指に挟まれた箇所の間隔（図１の２１５、２１６、２１７、２１８）：０．２５０λI_1＋０．２５０λI_2
ＩＤＴ－リフレクタ間隔：０．４７０λR
ｄｕｔｙ：０．６０（ＩＤＴ、リフレクタ共）電極膜厚：０．０８０λI_1
弾性表面波共振子２０２の詳細な設計を、以下に示す。
交叉幅Ｗ：４９．１λ
ＩＤＴ本数：４０１本
波長λ（ＩＤＴ、リフレクタ共）：２．０４μm
リフレクタ本数：３０本
ＩＤＴ－リフレクタ間隔：０．５０λ
ｄｕｔｙ：０．６０（ＩＤＴ、リフレクタ共）
電極膜厚：０．０８０λ
弾性表面波共振子２０３の詳細な設計を、以下に示す。
交叉幅Ｗ：４０．６λ
ＩＤＴ本数：２４１本
波長λ（ＩＤＴ、リフレクタ共）：１．９７μm
リフレクタ本数：３０本
ＩＤＴ－リフレクタ間隔：０．５０λ
ｄｕｔｙ：０．６０（ＩＤＴ、リフレクタ共）
電極膜厚：０．０８４λ
上記の「間隔」とは、２本の電極指の，幅方向での中心間距離のことである。

【００３９】図２に、実施の第一形態の構成での、周波数に対する平衡信号端子間の振幅平衡度、図３に位相平衡度のグラフを示す。図４に示す比較例としての弾性表面波フィルタでは、ＩＤＴ２０４及びＩＤＴ２０５の間隔とＩＤＴ２０５及びＩＤＴ２０６の間隔が同じである弾性表面波フィルタ部２０１ａを用いた。比較例の構成での振幅平衡度、位相平衡度も、図２、図３に合わせて示した。

【００４０】図４の比較例の構成は実施の第一形態に対して、ＩＤＴ２０４とＩＤＴ２０５の間隔とＩＤＴ２０５とＩＤＴ２０６の間隔を異ならせていない以外は、全く同じ構成である。ただし、圧電基板２０については用いているが記載を省略している。

【００４１】ＰＣＳ受信用フィルタにおける通過帯域の周波数範囲は１９３０ＭＨｚ～１９９０ＭＨｚである。この範囲での振幅平衡度は、比較例では－０．７５～＋２．３０ｄＢ（偏差３．０５ｄＢ、偏差が小さいほど振幅平衡度がよい）であるのに対し、実施の第一形態では－０．８０～＋２．３０ｄＢ（偏差３．１０ｄＢ）と若干悪化しているものの、位相平衡度は、比較例では－７．０～＋５．５度（偏差１２．５度、偏差が小さいほど位相平衡度がよい）であるに対し、実施の第一形態では－４．０～＋５．５度（偏差９．５度）と、約３．０度位相平衡度が改善している。

【００４２】これはＩＤＴ２０４及びＩＤＴ２０５の間隔と、ＩＤＴ２０５及びＩＤＴ２０６の間隔とを互いに異ならせることで、各平衡信号端子２１０、２１１につながっている電極指の総容量や、電気信号と弾性表面波の変換効率を是正したことによる効果である。このとき伝送特性は、図６に示すように、通過帯域内にわずかな不要なリップル（Ａ）が入っているが、それ以外は比較例とほぼ同じ特性が得られている（図５は比較例の伝送特性、図６は実施の第一形態の伝送特性）。

【００４３】ＩＤＴ－ＩＤＴ間隔を弾性表面波フィルタ部２０１の左右で互いに異ならせる場合、大きく異ならせると通過帯域内の不要リップルＡが大きくなるという問題があるので、実施の第一形態の効果を得るためのＩＤＴ－ＩＤＴ間隔の調整は、この不要リップルが大きくならない、望ましくは通過帯域内偏差に関する市場要求である１．０ｄＢよりも大きくならない範囲で行うことがよい。

【００４４】以上説明したように実施の第一形態では、平衡－不平衡変換機能を有する弾性表面波フィルタにおいて、左右でＩＤＴ－ＩＤＴ間隔を異ならせて、弾性表面波フィルタ部２０１の中央部にあるＩＤＴ２０５の中心部であって、かつ、弾性表面波の伝搬方向に対して垂直な仮想軸２２２に対して左右非対称な構造にすることで、比較例の弾性表面波フィルタよりも平衡信号端子間の位相平衡度が改善された弾性表面波フィルタが得られる。

【００４５】なお、実施の第一形態では、３つの各ＩＤＴ２０４、２０５、２０６を有する縦結合共振子型の弾性表面波フィルタ部２０１を１つ用い、弾性表面波フィルタ部２０１に２つの弾性表面波共振子２０２、２０３を直列接続した構成である、縦結合共振子型の弾性表面波フィルタの中央部のＩＤＴ２０５から平衡信号を得る構成で説明したが、本発明はこの構成に限らず、どのような構成の平衡信号端子を有する弾性表面波フィルタにおいても、同様な効果が得られる。

【００４６】例えば図７のように４つのＩＤＴを有する縦結合共振子型の弾性表面波フィルタにおいても、互いに隣り合うＩＤＴ－ＩＤＴの各間隔３０１、３０２を互いに異ならせることで、弾性表面波フィルタ部の中央部

であって、弾性表面波の伝搬方向に対して垂直に仮想軸３０３を設けた場合、この仮想軸３０３を挟んで左右非対称な構造になるので、実施の第一形態と同様な効果が得られる。

【００４７】また、それ以上の数のＩＤＴを有する弾性表面波フィルタにおいても、同様な効果が得られることも明らかである。例えば、弾性表面波共振子を弾性表面波フィルタ部２０１に対し並列接続した場合や、図８のように不平衡信号端子２０９を、縦結合共振子型の弾性表面波フィルタ部の各ＩＤＴ３０４、３０６のそれぞれ互いに逆側から入力（出力）した場合や、縦結合共振子型の弾性表面波フィルタ部を２段縦続接続した場合でも、例えば図８の仮想軸３２２を挟んで左右非対称な構造と設定することで、同様な効果が得られる。

【００４８】実施の第一形態では４０±５°ＹｃｕｔＸ伝搬$LiTaO_3$からなる圧電基板２０を用いたが、効果が得られる原理からもわかる通り、本発明は、上記圧電基板２０に限らず、６４°～７２°ＹｃｕｔＸ伝搬$LiNbO_3$、４１°ＹｃｕｔＸ伝搬$LiNbO_3$などからなる圧電基板でも同様な効果が得られる。

【００４９】（実施の第二形態）図９に、本発明に係る実施の第二形態の構成を示す。実施の第二形態では、図４に示す比較例の構成に対して、ＩＤＴ４０２の不平衡信号端子４０９に接続されている側の電極指のｄｕｔｙを、０．６０から０．５０に変更した点のみ異なる。すなわち、弾性表面波フィルタ４０１の中央部にあるＩＤＴ４０３の中心部に弾性表面波の伝搬方向に対して垂直な仮想軸４２０を想定した場合、この仮想軸４２０に対して左右非対称な構造になっていることになる。その他の構成は、比較例の構成とすべて同じである。

【００５０】図１０に、実施の第二形態の構成での、周波数に対する各平衡信号端子４１０、４１１間の振幅平衡度、図１１に位相平衡度のグラフを示す。比較例として、図４の比較例の構成での振幅平衡度、位相平衡度も図１０、図１１に合わせて示す。

【００５１】実施の第二形態ではＩＤＴ４０２の不平衡信号端子４０９に接続されている側の電極指のｄｕｔｙを変更しているので、比較来の構成より、通過周波数帯域が約１ＭＨｚ高くなる。

【００５２】図１０、図１１では実施の第二形態と比較例との比較がしやすいように、実施の第二形態の周波数を実際より１ＭＨｚ低く表示している。ＰＣＳ受信用フィルタにおける通過帯域の周波数範囲において振幅平衡度は、比較例では－０．７５ｄＢ～＋２．３０ｄＢ（偏差３．０５ｄＢ）であるのに対し、実施の第二形態では－０．７５～ｄＢ＋２．２５ｄＢ（偏差３．００ｄＢ）と約０．０５ｄＢ改善している。

【００５３】また位相平衡度は、比較例では－７．０度～＋５．５度（偏差１２．５度）であるに対し、実施の第二形態では－４．５度～＋５．０度（偏差９．５度）と、約３．０度位相平衡度が改善している。これはＩＤＴ４０２の不平衡信号端子４０９に接続されている側の電極指のｄｕｔｙを小さく設定することにより、各平衡信号端子４１０、４１１につながっている電極指の総容量や、電気と弾性表面波の変換効率を是正したことによる効果である。このとき通過帯域内の伝送特性は、比較例とほぼ同じ特性が得られている（図５：比較例の伝送特性、図１２：実施の第二形態の伝送特性）。

【００５４】以上説明したように実施の第二形態では、平衡－不平衡変換機能を有する弾性表面波フィルタにおいて、ＩＤＴ４０２の不平衡信号端子４０９に接続されている側の電極指のｄｕｔｙを小さくすることで、弾性表面波フィルタ４０１の中央部にあるＩＤＴ４０３の中心部に弾性表面波の伝搬方向に対して垂直な仮想軸４２０に対して左右非対称な構造にすることで、比較例の弾性表面波フィルタよりも平衡信号端子４１０、４１１間の平衡度が改善された弾性表面波フィルタが得られる。

【００５５】実施の第二形態ではシグナル電極のｄｕｔｙのみを変更したが、これはシグナル電極、アース電極の関係なくｄｕｔｙを変更して左右非対称な構造にすることで、実施の第二形態と同様な効果が得られる。また実施の第二形態ではｄｕｔｙを小さく変更したが、例えばＩＤＴ４０４のｄｕｔｙを変更する場合、逆にｄｕｔｙを大きくなるように変更する方が、平衡度が改善される。このようにｄｕｔｙの変更は、変更するＩＤＴによって大きくなる場合や小さくなる場合がある。

【００５６】（実施の第三形態）次に、本発明に係る実施の第三形態の構成を説明する。実施の第三形態の構成は、図４の比較例の構成に対し、図１３に示すように、図４のＩＤＴ２０４のピッチを、０．０１μｍだけ小さくしたＩＤＴ２０４ａを有する弾性表面波フィルタ部２０１ｂを用いた以外同じである。すなわち、弾性表面波フィルタ部２０１ｂは、その中央部にあるＩＤＴ２０５の中心部に弾性表面波の伝搬方向に対して垂直に仮想軸を想定した場合、この仮想軸に対して左右非対称な構造になっていることになる。

【００５７】図１４に、実施の第三形態の構成での、周波数に対する平衡信号端子間の振幅平衡度、図１５に位相平衡度のグラフを示す。比較として、図４の比較例の構成での振幅平衡度、位相平衡度も図１４、図１５に合わせて示す。

【００５８】実施の第三形態ではＩＤＴ２０４のピッチを、０．０１μｍだけ小さくしたＩＤＴ２０４ａを用いているので、比較例の構成より周波数が約１ＭＨｚ高くなる。図１４、図１５では実施の第三形態と比較例の比較がしやすいように、実施の第三形態の周波数を実際より１ＭＨｚ低く表示している。

【００５９】ＰＣＳ受信用の弾性表面波フィルタにおける通過帯域の周波数範囲において、振幅平衡度は、比較例では－０．７５ｄＢ～＋２．３０ｄＢ（偏差３．０５

ｄＢ）であるのに対し、実施の第三形態では－０．７５ｄＢ～＋２．４０ｄＢ（偏差３．１５ｄＢ）と若干悪化しているが、位相平衡度は、比較例では－７．０度～＋５．５度（偏差１２．５度）であるに対し、実施の第三形態では－３．５度～＋６．０度（偏差９．５度）と、約３．０度位相平衡度が改善している。

【００６０】これはＩＤＴ２０４のピッチを小さくしたＩＤＴ２０４ａを用いていることにより、各平衡信号端子２１０、２１１につながっている電極指の総容量や、電気と弾性表面波の変換効率を是正したことによる効果である。

【００６１】このとき通過帯域内の伝送特性は、わずかに通過帯域幅が比較例より狭くなっているものの、ほぼ比較例と同じ特性が得られている（図５：比較例の伝送特性、図１６：実施の第三形態の伝送特性）。

【００６２】以上説明したように実施の第三形態では、平衡－不平衡変換機能を有する弾性表面波フィルタにおいて、ＩＤＴ２０４のピッチを小さくしたＩＤＴ２０４ａを用いていることで、弾性表面波フィルタ部２０１ｂの中央部にあるＩＤＴ２０５の中心部に弾性表面波の伝搬方向に対して垂直な仮想軸に対して左右非対称な構造にすることで、比較例の弾性表面波フィルタよりも平衡信号端子２１０、２１１間の位相平衡度が改善された弾性表面波フィルタが得られる。

【００６３】実施の第三形態ではピッチを小さく変更したが、例えばＩＤＴ２０６のピッチを変更する場合、逆にピッチを大きく変更する方が、平衡度が改善される。このようにピッチの変更は、変更するＩＤＴによって大きくなる場合や小さくなる場合がある。

【００６４】また、図１７に示すように、狭ピッチ電極指部のピッチをＩＤＴ２０４とＩＤＴ２０５が隣り合う箇所とＩＤＴ２０５とＩＤＴ２０６が隣り合う箇所で互いに異ならせてもよい。例えば、図４に示すＩＤＴ２０４の狭ピッチ電極指部のピッチを小さく設定したＩＤＴ２０４ｂと、図４に示すＩＤＴ２０５におけるＩＤＴ２０４ｂ側の狭ピッチ電極指部のピッチを小さく設定したＩＤＴ２０５ａを有する弾性表面波フィルタ部２０１ｃを用いた以外は、図４と同様の構成とする。

【００６５】それゆえ、上記構成では、ＩＤＴ２０５ａが隣り合う箇所のピッチを、弾性表面波フィルタ部２０１ｃの中央部にあるＩＤＴ２０５ａの中心部で、弾性表面波の伝搬方向に対して垂直に想定した仮想軸に対して左右非対称な構造となっている。上記構造とすることでも、比較例の弾性表面波フィルタよりも平衡信号端子２１０、２１１間の平衡度が改善された弾性表面波フィルタが同様に得られる。

【００６６】以上の様に、本発明の弾性表面波フィルタでは、圧電基板上に弾性表面波の伝搬方向に沿って複数のＩＤＴを有し、平衡信号入力端子または平衡信号出力端子を有する弾性表面波フィルタであり、前記弾性表面波フィルタは電気的中性点を有さず（フロートバランスタイプ）、前記弾性表面波フィルタにおける各ＩＤＴの中央部に弾性表面波の伝搬方向に対して垂直に仮想軸を想定した場合、この仮想軸に対して前記弾性表面波フィルタが左右非対称であることを特徴とすることで、平衡信号端子間の平衡度（特に位相平衡度）を改善した弾性表面波フィルタが得られる。

【００６７】このとき、前記弾性表面波フィルタは奇数個のＩＤＴを有し、前記複数あるＩＤＴのうち中央に位置するＩＤＴの中心部に弾性表面波の伝搬方向に対して垂直に仮想軸を想定した場合、この仮想軸に対して左右非対称な構造を有することが望ましい。

【００６８】左右非対称な構造を有するようにする手段としては、（１）前記弾性表面波フィルタの隣り合うＩＤＴ同士の距離が、前記弾性表面波の伝搬方向に対して垂直に設けた仮想軸に対して左右非対称である箇所を有する、（２）前記弾性表面波フィルタの複数あるＩＤＴのｄｕｔｙが、前記弾性表面波の伝搬方向に対して垂直に設けた仮想軸に対して左右非対称である箇所を有する、（３）前記弾性表面波フィルタの複数あるＩＤＴのピッチが、前記弾性表面波の伝搬方向に対して垂直に設けた仮想軸に対して左右非対称である箇所を有する、（４）前記弾性表面波フィルタは２つのＩＤＴが隣り合う箇所に周囲の電極指よりピッチの小さい電極指を数本設けた狭ピッチ電極指部を有し、前記弾性表面波フィルタの狭ピッチ電極指部のピッチが、前記弾性表面波の伝搬方向に対して垂直に設けた仮想軸に対して左右非対称である箇所を有するなどの構成、方法が有効である。

【００６９】また、本発明の弾性表面波フィルタでは、通過帯域外の減衰量を大きくする上では、直列、もしくは並列、あるいはその両方に、弾性表面波共振子を少なくとも１つ以上接続することが望ましい。

【００７０】さらに、上記では、実施の第一ないし第三形態に記載の特徴を個々に設けた例を挙げたが、それらをどのように組み合わせて用いても、同様な効果を発揮できることは明らかである。

【００７１】次に、上記実施の第一ないし第三形態の何れかに記載の弾性表面波フィルタを用いた通信装置について図１８に基づき説明すると、上記通信装置６００は、受信を行うレシーバ側（Ｒｘ側）として、アンテナ６０１、アンテナ共用部／ＲＦＴｏｐフィルタ６０２、アンプ６０３、Ｒｘ段間フィルタ６０４、ミキサ６０５、１ｓｔＩＦフィルタ６０６、ミキサ６０７、２ｎｄＩＦフィルタ６０８、１ｓｔ＋２ｎｄローカルシンセサイザ６１１、ＴＣＸＯ（temperature compensatedcrystal oscillator（温度補償型水晶発振器））６１２、デバイダ６１３、ローカルフィルタ６１４を備えて構成されている。

【００７２】Ｒｘ段間フィルタ６０４からミキサ６０５へは、図１８に二本線で示したように、バランス性を確

保するために各平衡信号にて送信することが好ましい。

【００７３】また、上記通信装置６００は、送信を行うトランシーバ側（Ｔｘ側）として、上記アンテナ６０１及び上記アンテナ共用部／ＲＦＴｏｐフィルタ６０２を共用するとともに、ＴｘＩＦフィルタ６２１、ミキサ６２２、Ｔｘ段間フィルタ６２３、アンプ６２４、カプラ６２５、アイソレータ６２６、ＡＰＣ（automatic power control （自動出力制御））６２７を備えて構成されている。

【００７４】そして、上記のＲｘ段間フィルタ６０４、１ｓｔＩＦフィルタ６０６、ＴｘＩＦフィルタ６２１、Ｔｘ段間フィルタ６２３には、上述した本実施の第一ないし第三形態に記載の弾性表面波フィルタが好適に利用できる。

【００７５】本発明に係る弾性表面波フィルタは、フィルタ機能と共に不平衡－平衡変換機能を備え、その上、各平衡信号間の位相特性が理想により近いという優れた特性を有するものである。よって、上記弾性表面波フィルタを有する本発明の通信装置は、伝送特性を向上できるものとなっている。

【００７６】

【発明の効果】本発明の弾性表面波フィルタは、以上のように、圧電基板上に、弾性表面波の伝搬方向に沿って複数のＩＤＴを有するＩＤＴ連設体が設けられ、ＩＤＴ連設体に接続される平衡信号端子が設けられ、ＩＤＴ連設体は、ＩＤＴ連設体における弾性表面波の伝搬方向の中央部であって、上記伝搬方向に対して垂直となる仮想軸を挟んで非対称な構成である。

【００７７】それゆえ、上記構造は、ＩＤＴ連設体を、上記仮想軸を挟んで非対称に設定することにより、平衡度、特に位相平衡度を改善できるので、フィルタ機能を発揮できると共に、平衡度、特に位相平衡度が改善された平衡－不平衡変換機能を発揮できて、携帯電話等の通信装置に好適に適用できるという効果を奏する。

【図面の簡単な説明】

【図１】本発明に係る実施の第一形態の弾性表面波フィルタの概略構成図である。

【図２】上記実施の第一形態と比較例での振幅平衡度の差を示すグラフである。

【図３】上記実施の第一形態と比較例での位相平衡度の差を示すグラフである。

【図４】上記比較例としての弾性表面波フィルタの概略構成図である。

【図５】上記比較例の周波数－伝送特性を示すグラフである。

【図６】上記実施の第一形態の周波数－伝送特性を示すグラフである。

【図７】上記実施の第一形態の一変形例を示す概略構成図である。

【図８】上記実施の第一形態の他の変形例を示す概略構成図である。

【図９】本発明に係る実施の第二形態の弾性表面波フィルタの概略構成図である。

【図１０】上記実施の第二形態と比較例での振幅平衡度の差を示すグラフである。

【図１１】上記実施の第二形態と比較例での位相平衡度の差を示すグラフである。

【図１２】上記実施の第二形態の周波数－伝送特性を示すグラフである。

【図１３】本発明に係る実施の第三形態の弾性表面波フィルタの概略構成図である。

【図１４】上記実施の第三形態と比較例での振幅平衡度の差を示すグラフである。

【図１５】上記実施の第三形態と比較例での位相平衡度の差を示すグラフである。

【図１６】上記実施の第三形態の周波数－伝送特性を示すグラフである。

【図１７】上記実施の第三形態の一変形例を示す概略構成図である。

【図１８】本発明の通信装置の要部ブロック図である。

【図１９】平衡－不平衡変換機能を有する、従来の弾性表面波フィルタの概略構成図である。

【図２０】上記従来の弾性表面波フィルタにおける平衡信号端子の一方をアースに接続した概略構成図である。

【図２１】上記従来の弾性表面波フィルタにおける平衡信号端子の他方をアースに接続した概略構成図である。

【図２２】上記図２０と図２１との構成の周波数－振幅特性の差を示すグラフである。

【符号の説明】

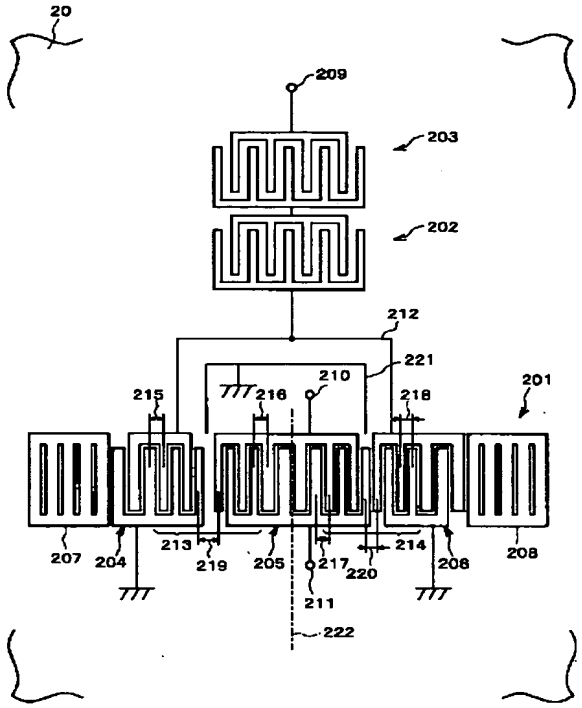
２０　　圧電基板

２０４、２０５、２０６　ＩＤＴ（くし型電極部）

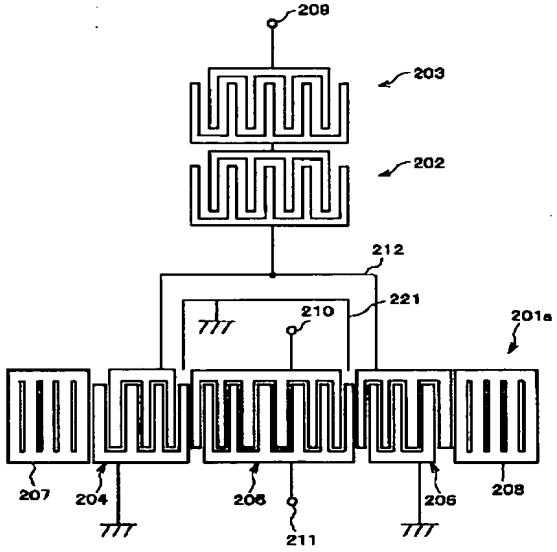
２１０、２１１　平衡信号端子

２２２　仮想軸

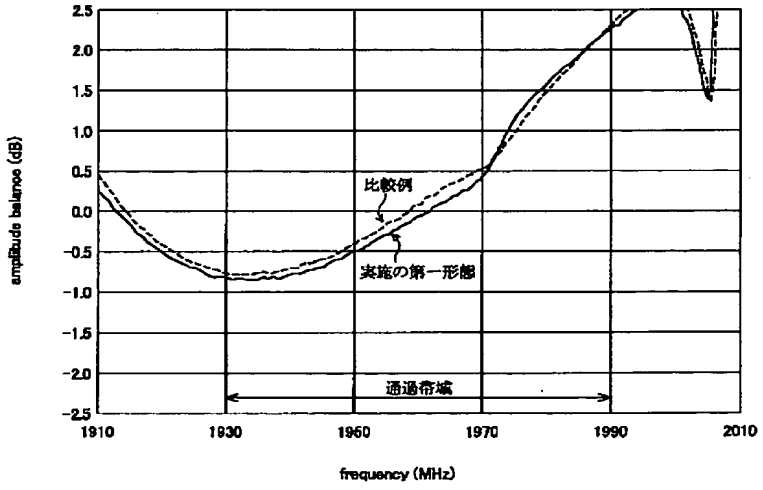
【図１】


20
209
203
202
212
221
210
201
215
216
218
207
204
213
219
205
217
220
214
206
208
211
222

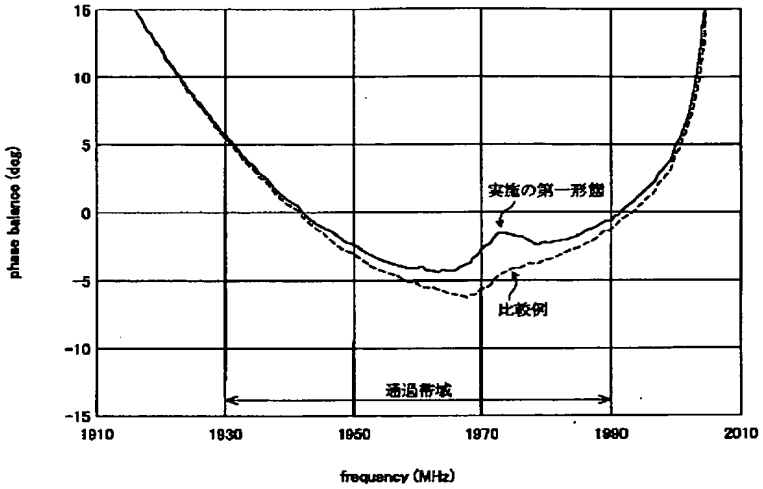
【図４】


209
203
202
212
221
210
201a
207
204
205
211
206
208

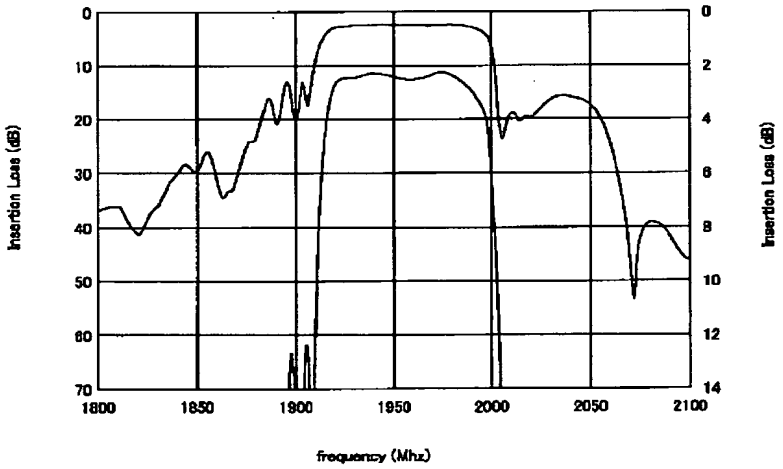
【図２】


2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
amplitude balance (dB)
比較例
実施の第一形態
通過帯域
1910
1930
1950
1970
1990
2010
frequency (MHz)

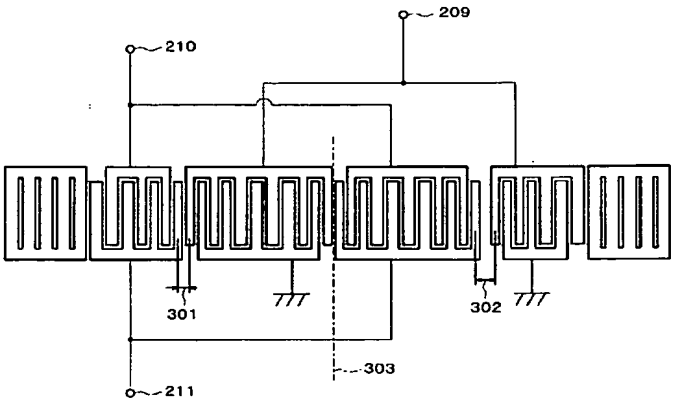
【図３】


15
10
5
0
-5
-10
-15
phase balance (deg)
実施の第一形態
比較例
通過帯域
1910
1930
1950
1970
1990
2010
frequency (MHz)

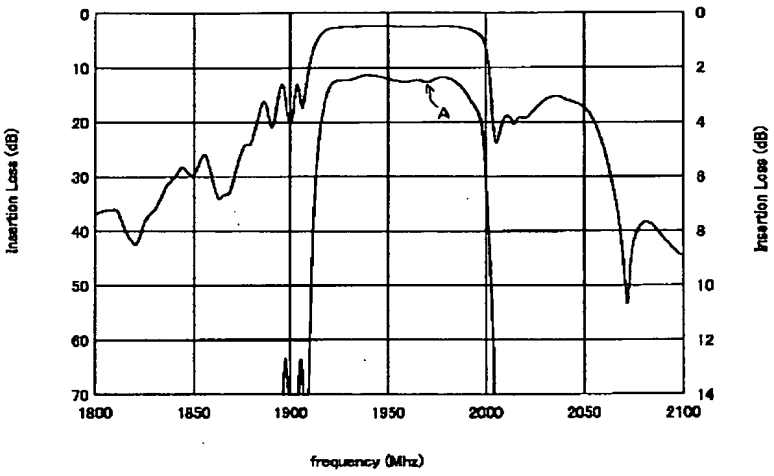
【図５】


0
10
20
30
40
50
60
70
Insertion Loss (dB)
0
2
4
6
8
10
12
14
Insertion Loss (dB)
1800
1850
1900
1950
2000
2050
2100
frequency (Mhz)

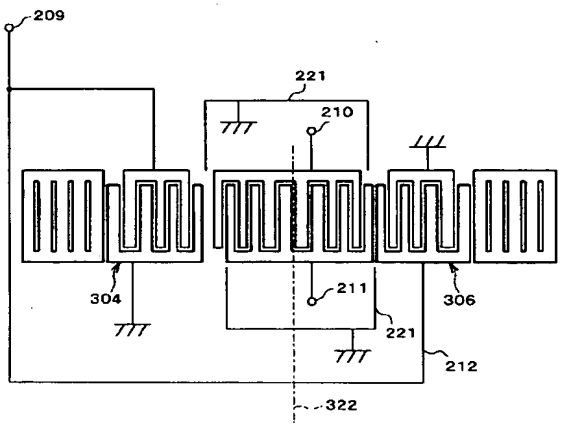
【図７】


209
210
301
302
303
211

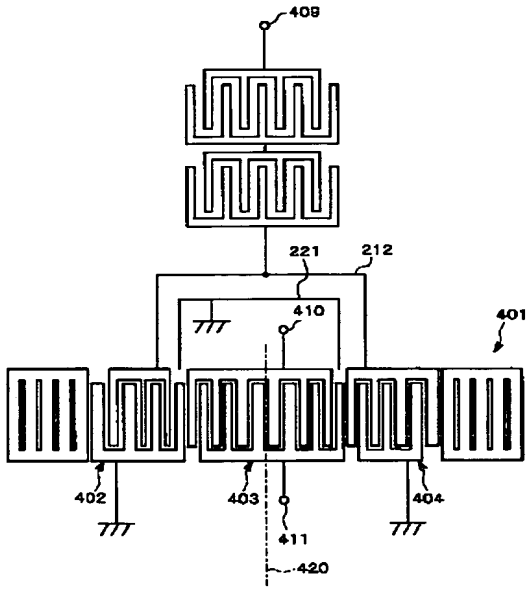
【図６】


Insertion Loss (dB)
Insertion Loss (dB)
frequency (Mhz)
A
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
1800
1850
1900
1950
2000
2050
2100

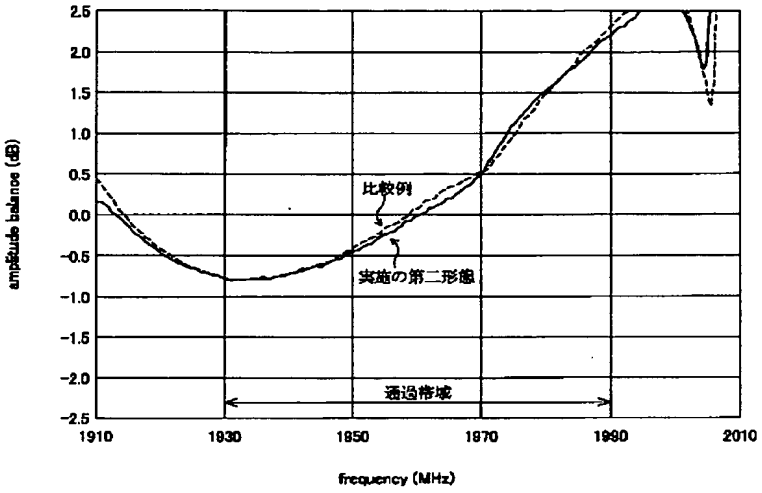
【図８】


209
221
210
304
211
221
306
212
322

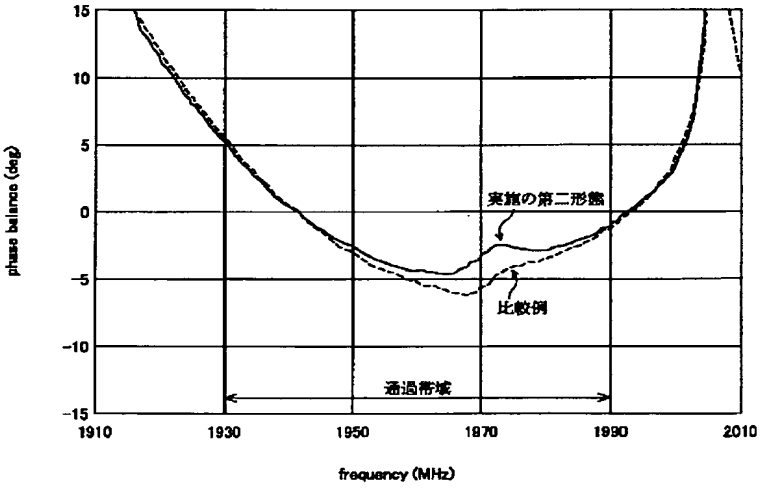
【図９】


409
221
212
410
401
402
403
404
411
420

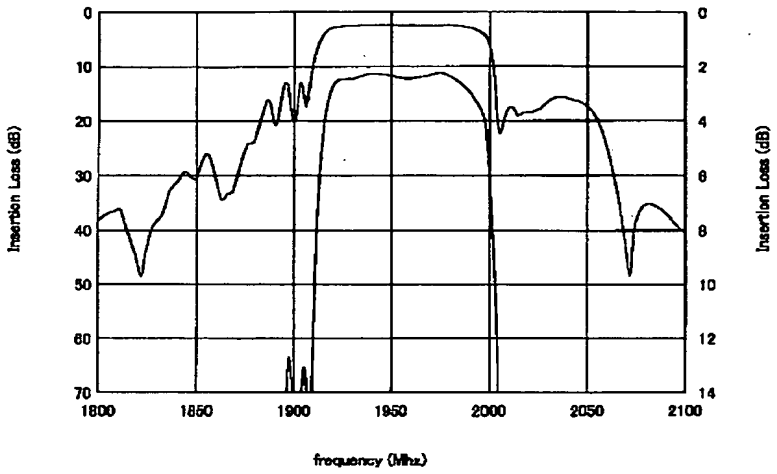
【図１０】


2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
amplitude balance (dB)
比較例
実施の第二形態
通過帯域
1910
1930
1950
1970
1990
2010
frequency (MHz)

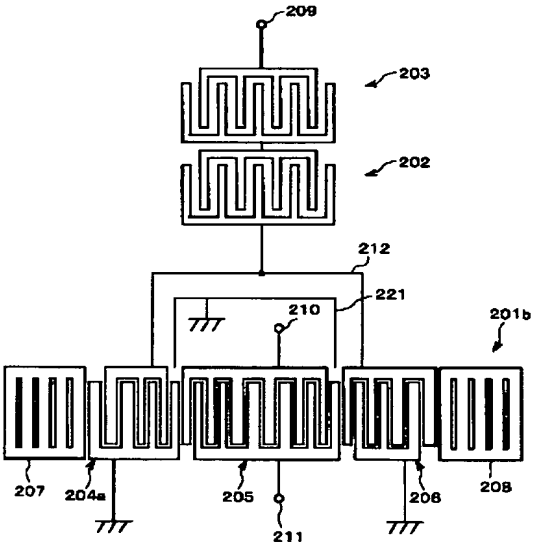
【図１１】


15
10
5
0
-5
-10
-15
phase balance (deg)
実施の第二形態
比較例
通過帯域
1910
1930
1950
1970
1990
2010
frequency (MHz)

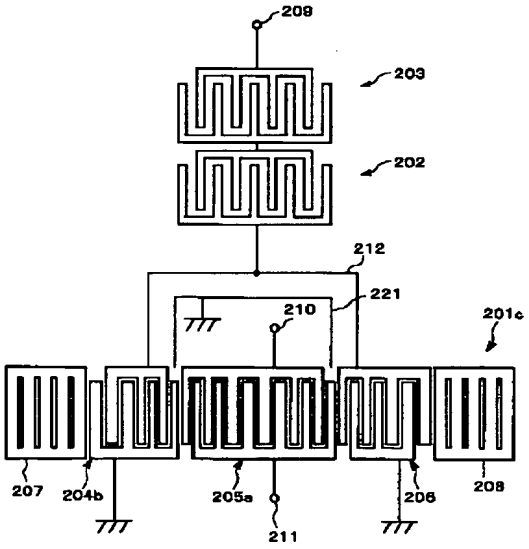
【図１２】


Insertion Loss (dB)
0
10
20
30
40
50
60
70
1800
1850
1900
1950
2000
2050
2100
frequency (Mhz)
0
2
4
6
8
10
12
14
Insertion Loss (dB)

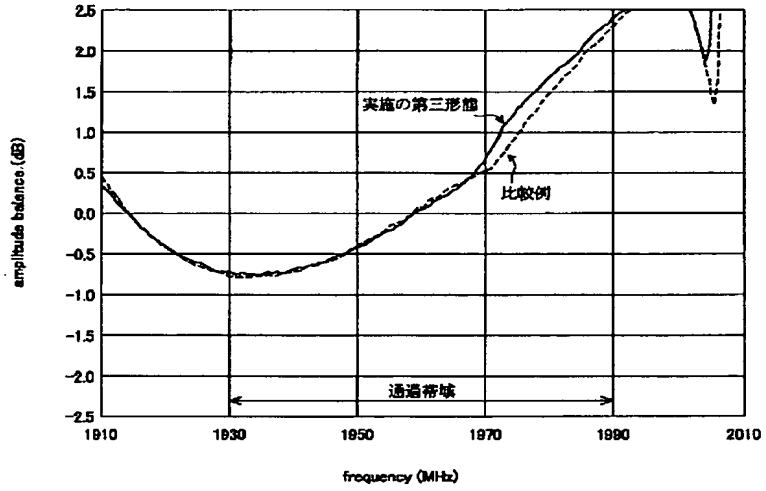
【図１３】


209
203
202
212
221
210
201b
207
204a
205
211
206
208

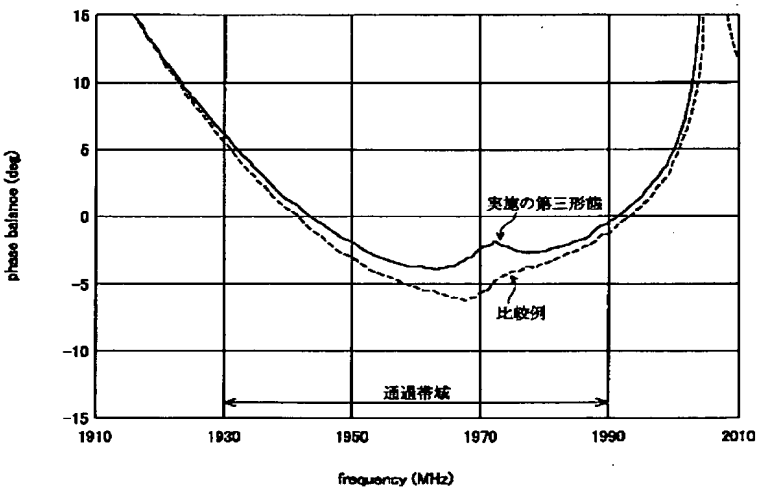
【図１７】


209
203
202
212
221
210
201c
207
204b
205a
211
206
208

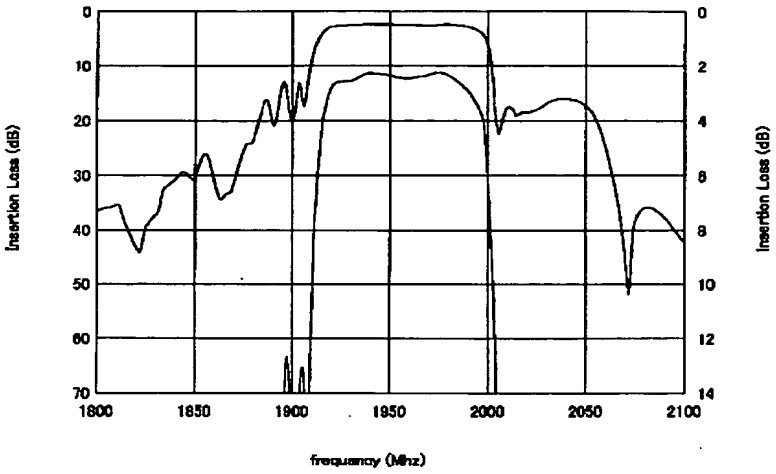
【図１４】


2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
amplitude balance (dB)
実施の第三形態
比較例
通過帯域
1910
1930
1950
1970
1990
2010
frequency (MHz)

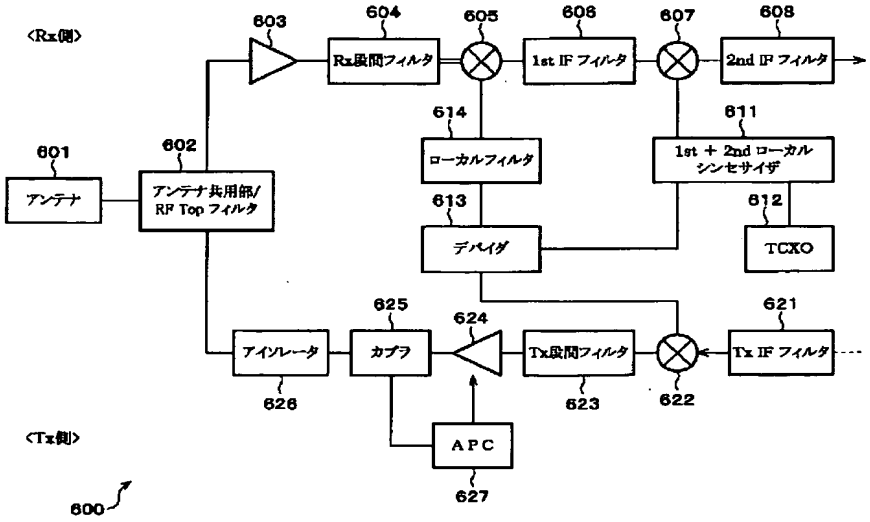
【図１５】


15
10
5
0
-5
-10
-15
phase balance (deg)
実施の第三形態
比較例
通過帯域
1910
1930
1950
1970
1990
2010
frequency (MHz)

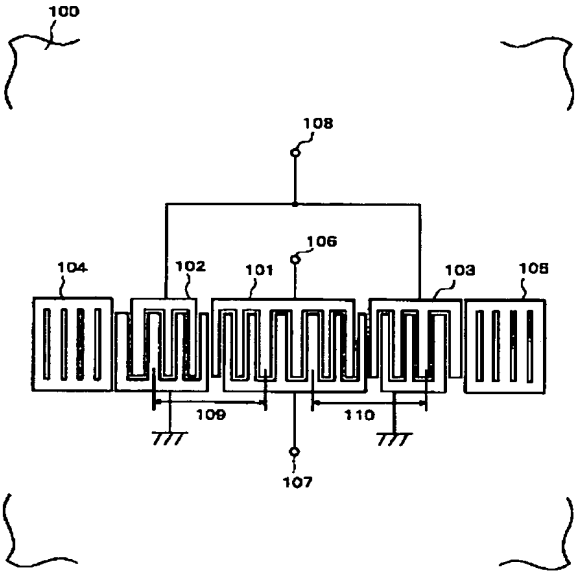
【図１６】


Insertion Loss (dB)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
1800
1850
1900
1950
2000
2050
2100
frequency (MHz)

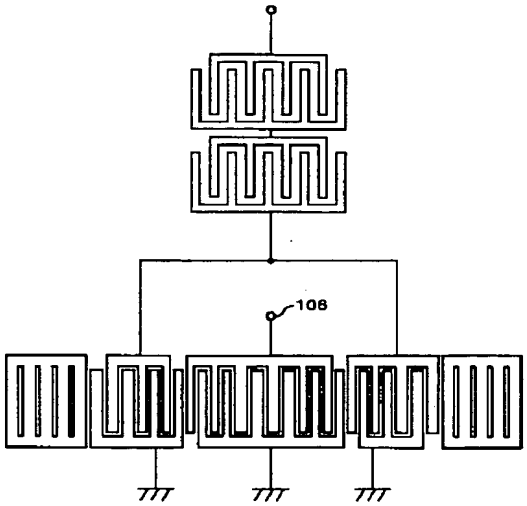
【図１８】


<Rx側>
603
604
Rx段間フィルタ
605
606
1st IF フィルタ
607
608
2nd IF フィルタ
614
ローカルフィルタ
611
1st + 2nd ローカル
シンセサイザ
601
アンテナ
602
アンテナ共用部/
RF Top フィルタ
613
デバイダ
612
TCXO
625
624
621
アイソレータ
カプラ
Tx段間フィルタ
Tx IF フィルタ
626
623
622
<Tx側>
APC
627
600

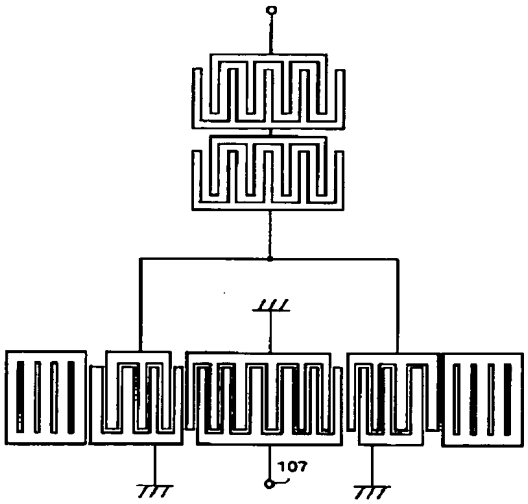
【図１９】



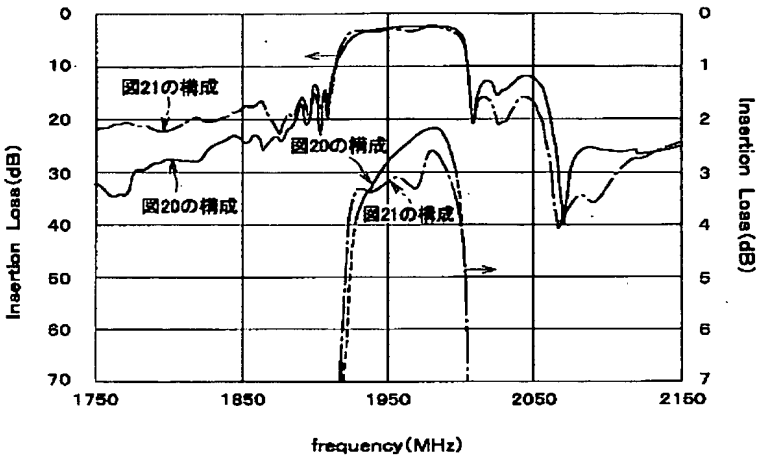
【図２０】



【図２１】



【図２２】


0
10
20
30
40
50
60
70
0
1
2
3
4
5
6
7
1750
1850
1950
2050
2150
Insertion Loss(dB)
Insertion Loss(dB)
frequency(MHz)
図21の構成
図20の構成
図20の構成
図21の構成

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

Bibliography

---

(19) [Publication country] Japan Patent Office (JP)
(12) [Kind of official gazette] Open patent official report (A)
(11) [Publication No.] JP,2003-46369,A (P2003-46369A)
(43) [Date of Publication] February 14, Heisei 15 (2003. 2.14)
(54) [Title of the Invention] A surface acoustic wave filter, a communication device
(51) [The 7th edition of International Patent Classification]

H03H 9/64
9/25

[FI]

H03H 9/64 Z
9/25 Z

[Request for Examination] Un-asking.
[The number of claims] 8
[Mode of Application] OL
[Number of Pages] 17
(21) [Application number] Application for patent 2001-228673 (P2001-228673)
(22) [Filing date] July 27, Heisei 13 (2001. 7.27)
(71) [Applicant]
[Identification Number] 000006231
[Name] Murata Manufacturing Co., Ltd.
[Address] 2-26-10, Tenjin, Nagaokakyo-shi, Kyoto
(72) [Inventor(s)]
[Name] Lofty peak Yuichi
[Address] 2-26-10, Tenjin, Nagaokakyo-shi, Kyoto Inside of Murata Manufacturing Co., Ltd.
(74) [Attorney]

[Identification Number] 100086034
[Patent Attorney]
[Name] Hara Kenzo
[Theme code (reference)]

5J097

[F term (reference)]

5J097 AA13 BB11 DD04 DD05 DD13 DD20 GG03 GG04

[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

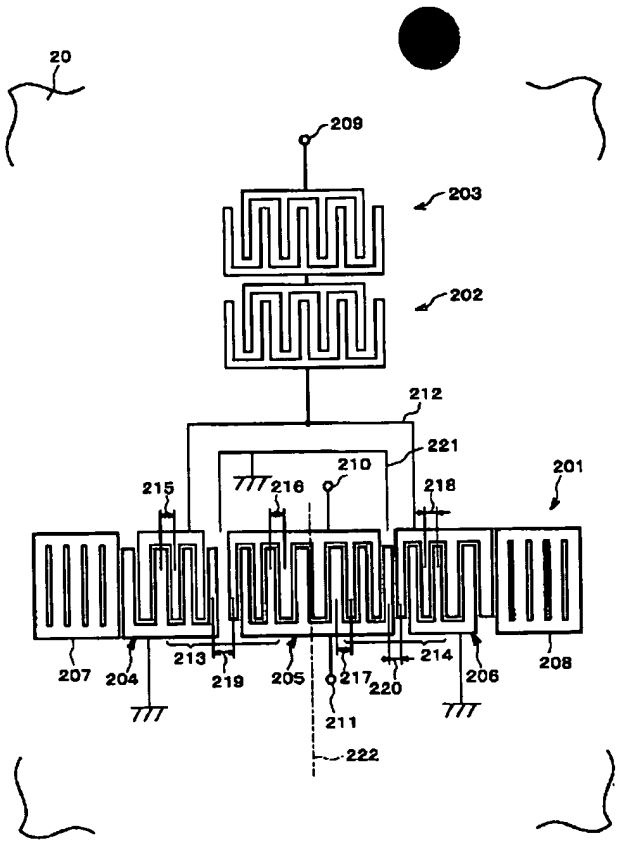
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

Epitome

---

(57) [Abstract]
[Technical problem] The surface acoustic wave filter and communication device which have improved the unbalance between each balanced signal terminal 210 and 211 are offered.
[Means for Solution] Each IDT 204, 205, and 206 is formed along the propagation direction of a surface acoustic wave. It connects with IDT205, respectively and each balanced signal terminals 210 and 211 are formed in it so that it may become a float balance type. It is the center section of the propagation direction of a surface acoustic wave in each IDT 204, 205, and 206, and each IDT 204, 205, and 206 is set up so that it may become right-and-left asymmetry to the virtual shaft 222 perpendicularly assumed to the above-mentioned propagation direction.

[Translation done.]



[Translation done.]

* NOTICES *

JPO and NCIPI are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] On a piezo-electric substrate, change an input electrical signal into a surface acoustic wave, and output and the comb mold polar-zone successive formation object which has two or more comb mold polar zone which changes and outputs the surface acoustic wave to spread to an output electrical signal along the propagation direction of a surface acoustic wave is established. It is the surface acoustic wave filter which the balanced signal terminal connected

to a comb mold polar-zone successive formation object is prepared, and is characterized by the unsymmetrical thing on both sides of the virtual shaft which a comb mold polar-zone successive formation object is the center section of the propagation direction of the surface acoustic wave in a comb mold polar-zone successive formation object, and becomes perpendicular to the above-mentioned propagation direction.

[Claim 2] It is the surface acoustic wave filter which said odd comb mold polar-zone successive formation objects go away, has the mold polar zone in a surface acoustic wave filter according to claim 1, and is characterized by setting said virtual shaft as the core of the comb mold polar zone located in the center among the comb mold polar zone which has more than one perpendicularly to the propagation direction of a surface acoustic wave.

[Claim 3] The surface acoustic wave filter with which distance of the comb mold polar zone of said comb mold polar-zone successive formation object which adjoin each other mutually is characterized by having an unsymmetrical part on both sides of said virtual shaft in a surface acoustic wave filter according to claim 1 or 2.

[Claim 4] The surface acoustic wave filter with which the ratio of an electrode digit to the pitch of said comb mold polar-zone successive formation object is characterized by having an unsymmetrical part on both sides of said virtual shaft in a surface acoustic wave filter given in any [claim 1 thru/or] of 3 they are.

[Claim 5] The surface acoustic wave filter with which the pitch of said comb mold polar-zone successive formation object is characterized by having an unsymmetrical part on both sides of said virtual shaft in a surface acoustic wave filter given in any [claim 1 thru/or] of 4 they are.

[Claim 6] It is the surface acoustic wave filter characterized by having the ** pitch electrode finger part which formed several electrode fingers with a pitch smaller than a surrounding electrode finger in the part where said two comb mold polar-zone successive formation objects go away in a surface acoustic wave filter given in any [claim 1 thru/or] of 5 they are, and the mold polar zone adjoins each other mutually, and the pitch of a ****** pitch electrode finger part having an unsymmetrical part on both sides of said virtual shaft.

[Claim 7] The surface acoustic wave filter characterized by connecting at least one surface acoustic wave resonator by either [at least] the serial or juxtaposition to said comb mold polar-zone successive formation object in a surface acoustic wave filter given in any [claim 1 thru/or] of 6 they are.

[Claim 8] The communication device characterized by having a surface acoustic wave filter given in any [claim 1 thru/or] of 7 they are.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the surface acoustic wave filter which has balanced - unbalance conversion function especially, and the communication device using it while having a filter shape.
[0002]
[Description of the Prior Art] The technical progress over the miniaturization of the portable telephone of the former and recent years and lightweight-izing has a remarkable thing. As a means for realizing this, development of the components which compounded the function of plurality [miniaturization / reduction of each component parts and] from the first has also progressed. Against the background of such a situation, what has balanced - unbalance conversion function and the function of the so-called balun (balun) is briskly studied by the surface acoustic wave filter used for RF stage of a portable telephone in recent years, and has come to be used for it focusing on a GSM method (Global System for Mobile communications) etc.
[0003] By an unbalanced current flowing, if direct continuation of a balanced line like a twin lead type feeder and an unbalanced line like a coaxial cable is carried out, since it operates [the feeder (feeder) itself] as an antenna and is not desirable, a balun will prevent an unbalanced current and will mean the circuit which adjusts a balanced line and an unbalanced line.
[0004] It applies also for some patents about the surface acoustic wave filter equipped with such a balanced - unbalance conversion function. As a surface acoustic wave filter with which the input impedance and the output impedance were equipped with almost equal balanced - unbalance conversion function, the configuration as shown in drawing 19 is known widely.
[0005] With the surface acoustic wave filter shown in drawing 19 , the comb mold polar zone (it is also called a blind-like electrode and is called IDT Inter-Digital Transducer and the following) 101 is formed on the piezo-electric substrate 100, and each IDT 102 and 103 is arranged at the right and left (it met in the propagation direction of a surface acoustic wave) which are

IDT101.

[0006] furthermore, the above-mentioned surface acoustic wave filter -- setting -- these every -- each reflectors 104 and 105 for reflecting a surface acoustic wave and raising conversion efficiency are arranged, respectively, and each balanced signal terminals 106 and 107 and the unbalance signal terminal 108 are formed so that IDT 101, 102, and 103 may be put from right and left.

[0007] Such a surface acoustic wave filter is called a 3IDT type vertical joint resonator mold surface acoustic wave filter, and has balanced - unbalance conversion function by conversion using the surface acoustic wave between each IDT 101 and 102 and 103.

[0008] With the surface acoustic wave filter which has balanced - unbalance conversion function, in the transmission characteristic in the passband between an unbalance signal terminal and each terminal of a balanced signal terminal, the amplitude characteristic is equal, and it is required that the phase should be reversed 180 degrees and it is calling it the amplitude unbalance between balanced signal terminals, and phase unbalance, respectively.

[0009] When amplitude unbalance and phase unbalance consider the surface acoustic wave filter which has said balanced - unbalance conversion function to be the device of three ports, for example, each of the first port and a balanced output terminal is made into the second port and the third port for an unbalanced input terminal, Amplitude unbalance =[A] A=|20log(S21) |-|20log(S31) |, phase unbalance = it defines as B-180 and B=|**S21-**S31|, respectively. In addition, S21 shows the transfer factor from the first port to the second port, and S31 shows the transfer factor from the first port to the third port, and || in each above-mentioned formula is to show an absolute value.

[0010] About the unbalance between such balanced signal terminals, 0dB and phase unbalance are ideally made into 0 times for amplitude unbalance in the passband of a surface acoustic wave filter.

[0011]

[Problem(s) to be Solved by the Invention] However, in the conventional configuration shown in drawing 19 , there was a problem that the unbalance between balanced signal terminals deteriorated. Although some of the reason is considered, a thing of the wavelength it is decided in the pitch of an electrode finger that the distance (109 of drawing 21) of the electrode finger connected to the balanced signal terminal 106 and the signal electrode finger of IDT102 and the distance (110 of drawing 21) of the electrode finger connected to the balanced signal terminal 107 and the signal electrode finger of IDT103 will be different 0.5 times is mentioned.

[0012] thereby -- the balanced signal terminals 106 and 107 -- the evil from which the total capacity of the electrode finger which is alike, respectively and is connected differs in which the conversion efficiency of the electrical and electric equipment and a surface acoustic wave

differs -- generating -- a result -- unbalance -- it had led to aggravation. The difference of the amplitude characteristic over the frequency which connects the balanced signal terminal 107 of drawing 19 to a ground like drawing 20 , and is outputted from the balanced signal terminal 106, and the amplitude characteristic which connects the balanced signal terminal 106 to a ground like drawing 21 , and is outputted from the balanced signal terminal 107 is shown in drawing 22 . The two amplitude characteristics differ greatly and this difference has led to aggravation of unbalance.

[0013] The purpose of this invention is correcting the difference between the above-mentioned balanced signal terminals which are the cause of the unbalance aggravation between balanced signal terminals, and is to offer the surface acoustic wave filter with which the unbalance between balanced signal terminals has good balanced - unbalance conversion function, and the communication device using it.

[0014]

[Means for Solving the Problem] In order that the surface acoustic wave filter of this invention may solve the above technical problem, on a piezo-electric substrate Change an input electrical signal into a surface acoustic wave, and output and the IDT successive formation object which has two or more IDT(s) which change and output the surface acoustic wave to spread to an output electrical signal along the propagation direction of a surface acoustic wave is established. The balanced signal terminal connected to an IDT successive formation object is prepared, and an IDT successive formation object is the center section of the propagation direction of the surface acoustic wave in an IDT successive formation object, and is characterized by the unsymmetrical thing on both sides of the virtual shaft which becomes perpendicular to the above-mentioned propagation direction. The above-mentioned balanced signal terminal has a desirable float balance type (type which does not have an electrical neutrality point).

[0015] In the above-mentioned surface acoustic wave filter, said IDT successive formation object has odd IDT(s), and said virtual shaft may be perpendicularly set as the core of IDT located in the center among IDT(s) which have more than one to the propagation direction of a surface acoustic wave.

[0016] With the above-mentioned surface acoustic wave filter, the distance of IDT(s) of said IDT successive formation object which adjoin each other mutually may have the unsymmetrical part on both sides of said virtual shaft.

[0017] In the above-mentioned surface acoustic wave filter, the ratio (duty) of an electrode digit to the pitch of said IDT successive formation object may have the unsymmetrical part on both sides of said virtual shaft.

[0018] With the above-mentioned surface acoustic wave filter, the pitch of said IDT successive formation object may have the unsymmetrical part on both sides of said virtual shaft.

[0019] In the above-mentioned surface acoustic wave filter, said IDT successive formation object may have the ** pitch electrode finger part which formed several electrode fingers with a pitch smaller than a surrounding electrode finger in the part where two IDT(s) adjoin each other mutually, and the pitch of a ****** pitch electrode finger part may have the unsymmetrical part on both sides of said virtual shaft.

[0020] Since the IDT successive formation object which has two or more IDT(s) along the propagation direction of a surface acoustic wave was established according to the above-mentioned configuration, a specific frequency band is passed and the filtering function which controls except [its] can be demonstrated.

[0021] Moreover, since the balanced signal terminal connect to an IDT successive-formation object be prepared in the above-mentioned configuration by the float balance type (type which do not have an electrical-neutrality point), while being able to demonstrate balanced - unbalance conversion function, it become that it be possible in set up comparatively easily the virtual shaft be the center section of the propagation direction of the surface acoustic wave in an IDT successive-formation object, and become that it be perpendicular to the above-mentioned propagation direction.

[0022] And in the above-mentioned configuration, duty of asymmetry or an IDT successive formation object is setting up asymmetrically the ** pitch electrode finger part by which asymmetry's, for example, the distance's of IDT(s) which adjoins each other's mutually, prepared the IDT successive formation object in asymmetry or an IDT successive formation object on both sides of said virtual shaft on both sides of said virtual shaft on both sides of the above-mentioned virtual shaft on both sides of said virtual shaft, and can improve unbalance, especially phase unbalance.

[0023] By these, the above-mentioned structure can demonstrate balanced - unbalance conversion function in which unbalance, especially phase unbalance have been improved, and can apply it suitable for communication devices, such as a cellular phone, while it can demonstrate a filtering function.

[0024] It is desirable that at least one surface acoustic wave resonator is connected by either [at least] the serial or juxtaposition to said IDT successive formation object with the above-mentioned surface acoustic wave filter. According to the above-mentioned configuration, a filtering function can be improved by having connected the surface acoustic wave resonator further.

[0025] The communication device of this invention is characterized by having a surface acoustic wave filter given in above any they are, in order to solve the aforementioned technical problem. Since according to the above-mentioned configuration the surface acoustic wave filter which can demonstrate balanced - unbalance conversion function in which unbalance, especially phase unbalance have been improved was used while being able to demonstrate

the filtering function, communication facility can be improved.

[0026]

[Embodiment of the Invention] It will be as follows if each gestalt of operation of this invention is explained based on drawing 1 thru/or drawing 19 .

[0027] (The first gestalt of operation) this invention -- starting -- operation -- the -- one -- a gestalt -- a surface acoustic wave -- a filter -- drawing 1 -- being shown -- as -- piezo-electricity -- a substrate -- 20 -- a top -- setting -- length -- association -- a resonator -- a mold -- a surface acoustic wave -- a filter -- the section (IDT successive formation object) -- 201 -- the above -- a surface acoustic wave -- a filter -- the section -- 201 -- receiving -- series connection -- carrying out -- having had -- a surface acoustic wave -- a resonator -- 202 -- a surface acoustic wave -- a resonator -- 203 -- photolithography -- a method -- etc. etc. -- forming -- having had -- aluminum -- (-- aluminum --) -- an electrode (foil) -- forming -- having -- **** . As a material of the piezo-electric substrate 20, it is the 40 **5-degreeYcutX propagation LiTaO3. It is mentioned. With the surface acoustic wave filter of each gestalt of future operations, it is PCS (Personal CommunicationSystem). It is explaining taking the case of the surface acoustic wave filter for reception.

[0028] In the surface acoustic wave filter section 201, each IDT 204 and 206 is formed so that IDT205 may be put from right and left along the propagation direction of a surface acoustic wave, and each reflectors 207 and 208 are formed in those both sides.

[0029] IDT is equipped with two or more two electrode finger parts equipped with the parallel band-like electrode finger of each other prolonged in the direction which intersects perpendicularly from the band-like end face section (bus bar) and one flank of the end face section, and has each above-mentioned electrode finger part in the condition of having become intricate between mutual electrode fingers so that the flank of the electrode finger of each above-mentioned electrode finger part might be met mutually.

[0030] Therefore, in IDT, if the potential difference based on an input electrical signal arises through each end face section (bus bar) to two electrode finger parts, a surface acoustic wave will occur on the front face of the piezo-electric substrate 20 of the part, and the surface acoustic wave will spread the front-face top of the piezo-electric substrate 20 in both directions of the cross direction (direction which intersects perpendicularly to the longitudinal direction of each electrode finger) of each electrode finger. On the other hand, in IDT into which the electrical signal is not inputted, each electrode finger detects the potential difference generated on the front face of the piezo-electric substrate 20 with the spread surface acoustic wave, and it can change and output to an output electrical signal.

[0031] In such IDT, a signal transformation property and a setup of a passband are possible by setting up the decussation width of face which shows the die length and width of face of each electrode finger, spacing of each adjacent electrode finger, and the confrontation die length in

the condition between mutual electrode fingers of having become intricate, respectively. Each above-mentioned reflector is for reflecting the spread surface acoustic wave.

[0032] Furthermore, in the surface acoustic wave filter section 201, the pitch of several electrode fingers (** pitch electrode finger) of the opposite part of IDT204 and IDT205 which adjoin each other mutually is made smaller than the electrode finger of other parts of IDT204 and IDT205 so that it may turn out that drawing 1 is seen (213 parts of drawing 1). Similarly, the pitch of several electrode fingers (** pitch electrode finger) of the opposite part of IDT205 and IDT206 which adjoin each other mutually is made smaller than the electrode finger of other parts of IDT205 and IDT206 (214 parts of drawing 1). Thereby, an insertion loss can be reduced in the surface acoustic wave filter section 201.

[0033] Moreover, it connects to each central electrode finger part of IDT205, respectively, and each balanced signal terminals 210 and 211 are formed. Thereby, the surface acoustic wave filter section 201 serves as a float balance type which does not have ground potential as an electrical neutrality point. It connects to one electrode finger part of IDT204 and IDT206, respectively, and the unbalance signal terminal 209 is formed. The electrode finger part of another side of IDT204 and IDT206 is connected to the ground.

[0034] Thus, it becomes possible to have balanced - unbalance conversion function in the surface acoustic wave filter section 201 by connecting each balanced signal terminals 210 and 211 and the unbalance signal terminal 209. That is, if a balanced electrical signal is inputted into each balanced signal terminals 210 and 211, while an unbalance electrical signal will be outputted from the unbalance signal terminal 209, when an unbalance electrical signal is inputted into the unbalance signal terminal 209, a balanced electrical signal will be outputted from each balanced signal terminals 210 and 211.

[0035] Series connection of the above-mentioned surface acoustic wave resonator 202 and the above-mentioned surface acoustic wave resonator 203 is carried out between the unbalance signal terminal 209 and each IDT 204 and 206 through the signal line 212. Incidentally, by drawing 1 , in order to make drawing brief, the number of an electrode finger is shown actually more few.

[0036] Furthermore, the earth line 221 is formed between the signal line 212 and the balanced signal terminal 210 as a shielding pattern for reducing the capacity which enters in bridge among above-mentioned both.

[0037] And with the surface acoustic wave filter of the first gestalt of operation, each IDT 204, 205, and 206 is set up so that spacing of IDT204 and IDT205 which adjoin each other mutually in the propagation direction of a surface acoustic wave may differ from spacing of IDT205 and IDT206 which adjoin each other mutually in the propagation direction of a surface acoustic wave too mutually. namely, the case where are the core of the propagation direction of a surface acoustic wave in IDT205 in the center section of the surface acoustic wave filter

section 201 in the surface acoustic wave filter of the first gestalt of operation, and the virtual shaft 222 is perpendicularly assumed to the propagation direction of a surface acoustic wave -- this virtual shaft 222 -- inserting -- right and left -- it will have unsymmetrical structure.

[0038] The detailed design of the surface acoustic wave filter section 201 of a vertical joint resonator mold the wavelength decided by the pitch of lambdaI2 (213 of drawing 1 , 214 parts), and other electrode fingers in the wavelength decided by the pitch of a ** pitch electrode finger -- lambdaI1 **, if it carries out Decussation Width-of-face W:60.6lambdaI1IDT number (order of 204, 205, and 206): -- (4)2929(4) / (4)45(4) (number of the electrode finger with which the inside of a parenthesis made the pitch small)

IDT wavelength lambdaI1 : 2.06 micrometers and lambdaI2 : 1.88-micrometer reflector wavelength lambdaR:2.07-micrometer reflector number: -- 100 IDT-IDT spacing: -- 0.500 -- lambdaI2 (219 of drawing 1), and 0.484lambdaI2 (220 of drawing 1)

Wavelength lambdaI1 Wavelength lambdaI2 The detailed design in the part inserted into the electrode finger of the spacing (215, 216, 217, 218 of drawing 1):0.250lambdaI1+0.250lambdaI2IDT-reflector spacing:0.470lambdaRduty:0.60 (IDT and reflector) electrode-layer thickness:0.080lambdaI1 surface-acoustic-wave resonator 202 is shown below.

Decussation Width-of-face W:49.1lambdaIDT number: -- 401 wavelength reflector number [of lambda (IDT and reflector):2.04 micrometers]: -- 30IDT-reflector spacing: -- 0.50lambdaduty:0.60 (IDT and reflector)

Electrode-layer thickness: The detailed design of the 0.080lambda surface acoustic wave resonator 203 is shown below.

Decussation Width-of-face W:40.6lambdaIDT number: -- 241 wavelength reflector number [of lambda (IDT and reflector):1.97 micrometers]: -- 30IDT-reflector spacing: -- 0.50lambdaduty:0.60 (IDT and reflector)

Electrode-layer thickness: "Spacing" of the 0.084lambda above is a pitch in the cross direction of two electrode fingers.

[0039] The graph of phase unbalance is shown in the amplitude unbalance between the balanced signal terminals to the frequency in the configuration of the first gestalt of operation, and drawing 3 at drawing 2 . With the surface acoustic wave filter as an example of a comparison shown in drawing 4 , the surface acoustic wave filter section 201a with same spacing of IDT204 and IDT205 and spacing of IDT205 and IDT206 was used. The amplitude unbalance in the configuration of the example of a comparison and phase unbalance were also shown according to drawing 2 and drawing 3 .

[0040] The configuration of the example of a comparison of drawing 4 is the completely same configuration except not changing spacing of IDT204 and IDT205, and spacing of IDT205 and IDT206 to the first gestalt of operation. However, the publication is omitted although used

about the piezo-electric substrate 20.

[0041] The frequency range of the passband in the filter for PCS reception is 1930MHz - 1990MHz. The amplitude unbalance in this range is -0.75-+2.30dB (the deflection of 3.05dB) at the example of a comparison. amplitude unbalance is so good that deflection is small -- it is -- although it is getting worse with the first gestalt of operation to a thing -0.80-+2.30dB (deflection of 3.10dB), and a little, phase unbalance the example of a comparison -7.0 - +5.5 degrees (phase unbalance is so good that 12.5 deflection and deflection are small) -- it is -- it received and whenever [phase equilibrium] has improved about about 3.0 degrees with -4.0 - +5.5 degrees (9.5 deflection) with the first gestalt of operation.

[0042] This is changing mutually spacing of IDT204 and IDT205, and spacing of IDT205 and IDT206, and it is the effectiveness by having corrected the total capacity of an electrode finger and the conversion efficiency of an electrical signal and a surface acoustic wave connected to each balanced signal terminals 210 and 211. At this time, although few unnecessary ripples (A) are contained in the passband as a transmission characteristic is shown in drawing 6 , the almost same property as the example of a comparison is acquired except it (drawing 5 is the transmission characteristic of the example of a comparison, and drawing 6 is the transmission characteristic of the first gestalt of operation).

[0043] Since there is a problem that the unnecessary ripple A in a passband becomes large when it changes IDT-IDT spacing mutually by right and left of the surface acoustic wave filter section 201, and it is made to differ greatly, adjustment of IDT-IDT spacing for acquiring the effectiveness of the first gestalt of operation is good to carry out in the range in which this unnecessary ripple does not become large, which is the commercial scene demand about the deflection in a passband desirably and which does not become larger than 1.0dB.

[0044] In the surface acoustic wave filter which has balanced - unbalance conversion function with the first gestalt of operation as explained above the core of IDT205 which changes IDT-IDT spacing by right and left, and is in the center section of the surface acoustic wave filter section 201 -- it is -- and the propagation direction of a surface acoustic wave -- receiving -- the perpendicular virtual shaft 222 -- receiving -- right and left -- by making it unsymmetrical structure The surface acoustic wave filter with which the phase unbalance between balanced signal terminals has been improved rather than the surface acoustic wave filter of the example of a comparison is obtained.

[0045] In addition, with the first gestalt of operation, the one surface acoustic wave filter section 201 of a vertical joint resonator mold which has each three IDT(s) 204, 205, and 206 is used. Although the configuration which acquires a balanced signal explained from IDT205 of the center section of the surface acoustic wave filter of the vertical joint resonator mold which is the configuration which carried out series connection of the two surface acoustic wave resonators 202 and 203 to the surface acoustic wave filter section 201 The same effectiveness

is acquired also in the surface acoustic wave filter with which this invention has the balanced signal terminal of not only this configuration but what kind of configuration.

[0046] for example, the case where are the center section of the surface acoustic wave filter section, and the virtual shaft 303 is perpendicularly established to the propagation direction of a surface acoustic wave by changing mutually each spacing 301 and 302 of IDT-IDT which adjoins each other mutually also in the surface acoustic wave filter of the vertical joint resonator mold which has four IDT(s) like drawing 7 -- this virtual shaft 303 -- inserting -- right and left -- since it becomes unsymmetrical structure, the same effectiveness as the first gestalt of operation is acquired.

[0047] Moreover, also in the surface acoustic wave filter which has IDT of the number beyond it, it is also clear that the same effectiveness is acquired. for example, the case where parallel connection of the surface acoustic wave resonator is carried out to the surface acoustic wave filter section 201 and drawing 8 -- like -- the unbalance signal terminal 209 -- every of the surface acoustic wave filter section of a vertical joint resonator mold -- the case of IDT 304 and 306 where it inputs from a reverse side mutually, respectively (output), and the case where two step cascade connection of the surface acoustic wave filter section of a vertical joint resonator mold is carried out -- the virtual shaft 322 of drawing 8 -- inserting -- right and left -- the same effectiveness is acquired by setting up with unsymmetrical structure.

[0048] the first gestalt of operation -- 40 **5-degreeYcutX propagation LiTaO3 from -- as the principle from which effectiveness is acquired also showing, although the becoming piezo-electric substrate 20 was used -- this invention -- not only the above-mentioned piezo-electric substrate 20 but the 64 degrees - 72 degreeYcutX propagation LiNbO3, and 41-degreeYcutX propagation LiNbO3 etc. -- from -- the same effectiveness is acquired also with the becoming piezo-electric substrate.

[0049] (The second gestalt of operation) The configuration of the second gestalt of the operation which relates to this invention at drawing 9 is shown. With the second gestalt of operation, it differs to the configuration of the example of a comparison shown in drawing 4 in that duty of the electrode finger of the side connected to the unbalance signal terminal 409 of IDT402 was changed into 0.50 from 0.60. namely, the case where the perpendicular virtual shaft 420 is assumed to the propagation direction of a surface acoustic wave to the core of IDT403 in the center section of the surface acoustic wave filter 401 -- this virtual shaft 420 -- receiving -- right and left -- it will have unsymmetrical structure. Other configurations are altogether the same as the configuration of the example of a comparison.

[0050] The graph of phase unbalance is shown in each balanced signal terminal 410 to the frequency in the configuration of the second gestalt of operation, the amplitude unbalance between 411, and drawing 11 at drawing 10 . As an example of a comparison, the amplitude unbalance in the configuration of the example of a comparison of drawing 4 and phase

unbalance are also shown according to drawing 10 and drawing 11 .

[0051] since duty of the electrode finger of the side connected to the unbalance signal terminal 409 of IDT402 with the second gestalt of operation is changed, about 1MHz of passage frequency bands becomes high from the configuration since a comparison.

[0052] In drawing 10 and drawing 11 , 1MHz of frequencies of the second gestalt of operation is low displayed actually more so that it may be easy to carry out the comparison with the second gestalt of operation, and the example of a comparison. In the frequency range of the passband in the filter for PCS reception, about 0.05dB of amplitude unbalance has improved with -0.75-dB+2.25dB (deflection of 3.00dB) with the second gestalt of operation to being - 0.75dB - +2.30dB (deflection of 3.05dB) in the example of a comparison.

[0053] moreover, phase unbalance -- the example of a comparison -7.0 - +5.5 degrees (12.5 deflection) -- it is -- it received and whenever [phase equilibrium] has improved about about 3.0 degrees with -4.5 - +5.0 degrees (9.5 deflection) with the second gestalt of operation. By setting up small duty of the electrode finger of the side connected to the unbalance signal terminal 409 of IDT402, this is the effectiveness by having corrected the total capacity of an electrode finger and the conversion efficiency of the electrical and electric equipment and a surface acoustic wave connected to each balanced signal terminals 410 and 411. At this time, the property as the example of a comparison that the transmission characteristic in a passband is almost the same is acquired (drawing 5 : the transmission characteristic of the example of a comparison, transmission characteristic of the second gestalt of the drawing 12 :operation).

[0054] As explained above, with the second gestalt of operation, duty of the electrode finger of the side connected to the unbalance signal terminal 409 of IDT402 by making it small in the surface acoustic wave filter which has balanced - unbalance conversion function the core of IDT403 in the center section of the surface acoustic wave filter 401 -- the propagation direction of a surface acoustic wave -- receiving -- the perpendicular virtual shaft 420 -- receiving -- right and left -- by making it unsymmetrical structure The balanced signal terminal 410 and the surface acoustic wave filter with which the unbalance between 411 has been improved are obtained rather than the surface acoustic wave filter of the example of a comparison.

[0055] although only duty of a signal electrode was changed with the second gestalt of operation -- this -- a signal electrode and a ground electrode -- not related -- duty -- changing -- right and left -- it is making it unsymmetrical structure and the same effectiveness as the second gestalt of operation is acquired. Moreover, although duty was small changed with the second gestalt of operation, when changing duty of IDT404, for example, unbalance is improved for the direction which changes duty conversely so that it may become large. Thus, modification of duty may become small when becoming large by IDT to change.

[0056] (The third gestalt of operation) Next, the configuration of the third gestalt of operation concerning this invention is explained. The configuration of the third gestalt of operation is the

same except having used surface acoustic wave filter section 201b which has IDT204a which made small only 0.01 micrometers of pitches of IDT204 of drawing 4 , as shown in drawing 13 to the configuration of the example of a comparison of drawing 4 . namely, the case where surface acoustic wave filter section 201b assumes a virtual shaft perpendicularly to the propagation direction of a surface acoustic wave to the core of IDT205 in that center section -- this virtual shaft -- receiving -- right and left -- it will have unsymmetrical structure.

[0057] The graph of phase unbalance is shown in the amplitude unbalance between the balanced signal terminals to the frequency in the configuration of the third gestalt of operation, and drawing 15 at drawing 14 . As a comparison, the amplitude unbalance in the configuration of the example of a comparison of drawing 4 and phase unbalance are also shown according to drawing 14 and drawing 15 .

[0058] Since IDT204a which made small only 0.01 micrometers of pitches of IDT204 is used with the third gestalt of operation, about 1MHz of frequencies becomes high from the configuration of the example of a comparison. In drawing 14 and drawing 15 , 1MHz of frequencies of the third gestalt of operation is low displayed actually more so that it may be easy to consider the comparison of the example of a comparison as the third gestalt of operation.

[0059] In the frequency range of the passband in the surface acoustic wave filter for PCS reception amplitude unbalance Although it is getting worse with the third gestalt of operation to being -0.75dB - +2.30dB (deflection of 3.05dB) in the example of a comparison -0.75dB - +2.40dB (deflection of 3.15dB), and a little phase unbalance -- the example of a comparison - 7.0 - +5.5 degrees (12.5 deflection) -- it is -- it received and whenever [phase equilibrium] has improved about about 3.0 degrees with -3.5 - +6.0 degrees (9.5 deflection) with the third gestalt of operation.

[0060] By using IDT204a which made the pitch of IDT204 small, this is the effectiveness by having corrected the total capacity of an electrode finger and the conversion efficiency of the electrical and electric equipment and a surface acoustic wave connected to each balanced signal terminals 210 and 211.

[0061] At this time, although pass band width has become narrower than the example of a comparison slightly as for the transmission characteristic in a passband, the almost same property as the example of a comparison is acquired (drawing 5 : the transmission characteristic of the example of a comparison, transmission characteristic of the third gestalt of the drawing 16 :operation).

[0062] As explained above, with the third gestalt of operation, by using IDT204a which made the pitch of IDT204 small in the surface acoustic wave filter which has balanced - unbalance conversion function the core of IDT205 in the center section of surface acoustic wave filter section 201b -- the propagation direction of a surface acoustic wave -- receiving -- a

perpendicular virtual shaft -- receiving -- right and left -- by making it unsymmetrical structure The balanced signal terminal 210 and the surface acoustic wave filter with which the phase unbalance between 211 has been improved are obtained rather than the surface acoustic wave filter of the example of a comparison.

[0063] Although the pitch was small changed with the third gestalt of operation, when changing the pitch of IDT206, for example, unbalance is improved for the direction which changes a pitch greatly conversely. Thus, modification of a pitch may become small when becoming large by IDT to change.

[0064] Moreover, as shown in drawing 17 , the pitch of a ** pitch electrode finger part may be changed mutually in the part where IDT204 and IDT205 adjoin each other, and the part where IDT205 and IDT206 adjoin each other. For example, it considers as the same configuration as drawing 4 except having used surface acoustic wave filter section 201c which has IDT205a which set up small the pitch of the ** pitch electrode finger part by the side of IDT204b which set up small the pitch of the ** pitch electrode finger part of IDT204 shown in drawing 4 ; and IDT204b in IDT205 which shows drawing 4 .

[0065] so, the virtual shaft which assumed perpendicularly the pitch of the part where IDT205a adjoins each other to the propagation direction of a surface acoustic wave with the above-mentioned configuration in the core of IDT205a in the center section of surface acoustic wave filter section 201c -- receiving -- right and left -- it has unsymmetrical structure. Considering as the above-mentioned structure, the balanced signal terminal 210 and the surface acoustic wave filter with which the unbalance between 211 has been improved are similarly obtained rather than the surface acoustic wave filter of the example of a comparison.

[0066] as mentioned above, with the surface acoustic wave filter of this invention It is the surface acoustic wave filter which has two or more IDT(s) along the propagation direction of a surface acoustic wave on a piezo-electric substrate, and has a balanced signal input terminal or a balanced signal output terminal. Said surface acoustic wave filter does not have an electrical neutrality point (float balance type). every in said surface acoustic wave filter -- by it being characterized by said surface acoustic wave filter being right-and-left asymmetry to this virtual shaft, when a virtual shaft is perpendicularly assumed to the propagation direction of a surface acoustic wave in the center section of IDT The surface acoustic wave filter which has improved the unbalance between balanced signal terminals (especially phase unbalance) is obtained.

[0067] the case where a virtual shaft is perpendicularly assumed to the propagation direction of a surface acoustic wave to the core of IDT which said surface acoustic wave filter has odd IDT (s), and is located in the center among said IDT(s) which have more than one at this time -- this virtual shaft -- receiving -- right and left -- it is desirable to have unsymmetrical structure.

[0068] right and left -- as a means to make it have unsymmetrical structure (1) The distance of

IDT(s) which said surface acoustic wave filter adjoins has the part which is right-and-left asymmetry to the virtual shaft perpendicularly established to the propagation direction of said surface acoustic wave. (2) duty of IDT with two or more said surface acoustic wave filters has the part which is right-and-left asymmetry to the virtual shaft perpendicularly established to the propagation direction of said surface acoustic wave. (3) The pitch of IDT with two or more said surface acoustic wave filters has the part which is right-and-left asymmetry to the virtual shaft perpendicularly established to the propagation direction of said surface acoustic wave. (4) Said surface acoustic wave filter has the ** pitch electrode finger part which formed several electrode fingers with a pitch smaller than a surrounding electrode finger in the part where two IDT(s) adjoin each other. The configuration of the pitch of the ** pitch electrode finger part of said surface acoustic wave filter having the part which is right-and-left asymmetry to the virtual shaft perpendicularly established to the propagation direction of said surface acoustic wave, and an approach are effective.

[0069] Moreover, when enlarging the magnitude of attenuation outside a passband with the surface acoustic wave filter of this invention, it is desirable to connect at least one or more surface acoustic wave resonators to a serial, juxtaposition, or its both.

[0070] Furthermore, although the example which established the description of a publication separately was given in the first of operation thru/or the third gestalt above, even if it uses combining them how, it is clear that the same effectiveness can be demonstrated.

[0071] When the communication device using a surface acoustic wave filter given in any of the first of the above-mentioned implementation thru/or the third gestalt they are is explained based on drawing 18 , next, the above-mentioned communication device 600 As a receiver side (Rx side) which receives An antenna 601, the antenna common section / RFTop filter 602, amplifier 603, Rx interstage filter 604, a mixer 605, the 1stIF filter 606, a mixer 607, the 2ndIF filter 608, the 1st+2nd local synthesizer 611, TCXO (temperature compensatedcrystal oscillator (temperature-compensated crystal oscillator)) It has 612, a divider 613, and the local filter 614, and is constituted.

[0072] As double lines showed, in order to secure balance nature from Rx interstage filter 604 to drawing 18 to a mixer 605, transmitting by each balanced signal is desirable.

[0073] Moreover, as a transceiver side (Tx side) which transmits, it has the TxIF filter 621, a mixer 622, Tx interstage filter 623, amplifier 624, a coupler 625, an isolator 626, and APC (automatic power control)627 (APC), and the above-mentioned communication device 600 is constituted while sharing the above-mentioned antenna 601, and the above-mentioned above-mentioned antenna common section / RFTop filter 602.

[0074] And a surface acoustic wave filter given in the first of this operation thru/or the third gestalt mentioned above can use for the above-mentioned Rx interstage filter 604, the 1stIF filter 606, the TxIF filter 621, and Tx interstage filter 623 suitably.

[0075] The surface acoustic wave filter concerning this invention is equipped with an unbalance-balance conversion function with a filtering function, and, moreover, the phase characteristic between each balanced signal has the outstanding property of being near, by the ideal. Therefore, the communication device of this invention which has the above-mentioned surface acoustic wave filter can be improving the transmission characteristic.
[0076]
[Effect of the Invention] The IDT successive-formation object which has two or more IDT(s) along the propagation direction of a surface acoustic wave is established on a piezo-electric substrate as mentioned above, the balanced signal terminal connected to an IDT successive-formation object is prepared, an IDT successive-formation object is the center section of the propagation direction of the surface acoustic wave in an IDT successive-formation object, and the surface acoustic wave filter of this invention is an unsymmetrical configuration on both sides of the virtual shaft which becomes perpendicular to the above-mentioned propagation direction.
[0077] So, it can demonstrate balanced - unbalance conversion function in which unbalance, especially phase unbalance have been improved, and does the effectiveness that it is applicable suitable for communication devices, such as a cellular phone, while it can demonstrate a filtering function, since the above-mentioned structure can improve unbalance, especially phase unbalance by setting up an IDT successive formation object asymmetrically on both sides of the above-mentioned virtual shaft.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the outline block diagram of the surface acoustic wave filter of the first gestalt of operation concerning this invention.

[Drawing 2] It is the graph which shows the first gestalt of the above-mentioned implementation, and the difference of the amplitude unbalance in the example of a comparison.
[Drawing 3] It is the graph which shows the first gestalt of the above-mentioned implementation, and the difference of the phase unbalance in the example of a comparison.
[Drawing 4] It is the outline block diagram of the surface acoustic wave filter as the above-mentioned example of a comparison.
[Drawing 5] It is the graph which shows the frequency-transmission characteristic of the above-mentioned example of a comparison.
[Drawing 6] It is the graph which shows the frequency-transmission characteristic of the first gestalt of the above-mentioned implementation.
[Drawing 7] It is the outline block diagram showing the example of a complete-change form of the first gestalt of the above-mentioned implementation.
[Drawing 8] It is the outline block diagram showing other modifications of the first gestalt of the above-mentioned implementation.
[Drawing 9] It is the outline block diagram of the surface acoustic wave filter of the second gestalt of operation concerning this invention.
[Drawing 10] It is the graph which shows the second gestalt of the above-mentioned implementation, and the difference of the amplitude unbalance in the example of a comparison.
[Drawing 11] It is the graph which shows the second gestalt of the above-mentioned implementation, and the difference of the phase unbalance in the example of a comparison.
[Drawing 12] It is the graph which shows the frequency-transmission characteristic of the second gestalt of the above-mentioned implementation.
[Drawing 13] It is the outline block diagram of the surface acoustic wave filter of the third gestalt of operation concerning this invention.
[Drawing 14] It is the graph which shows the third gestalt of the above-mentioned implementation, and the difference of the amplitude unbalance in the example of a comparison.
[Drawing 15] It is the graph which shows the third gestalt of the above-mentioned implementation, and the difference of the phase unbalance in the example of a comparison.
[Drawing 16] It is the graph which shows the frequency-transmission characteristic of the third gestalt of the above-mentioned implementation.
[Drawing 17] It is the outline block diagram showing the example of a complete-change form of the third gestalt of the above-mentioned implementation.
[Drawing 18] It is the important section block diagram of the communication device of this invention.

[Drawing 19] It is the outline block diagram of the conventional surface acoustic wave filter which has balanced - unbalance conversion function.
[Drawing 20] It is the outline block diagram which connected one side of the balanced signal terminal in the above-mentioned conventional surface acoustic wave filter to the ground.
[Drawing 21] It is the outline block diagram which connected another side of the balanced signal terminal in the above-mentioned conventional surface acoustic wave filter to the ground.

[Drawing 22] It is the graph which shows the difference of the frequency-amplitude characteristic of a configuration with above-mentioned drawing 20 and drawing 21 .
[Description of Notations]
20 Piezo-electric Substrate
204, 205, 206 IDT (comb mold polar zone)
210 211 Balanced signal terminal
222 Virtual Shaft

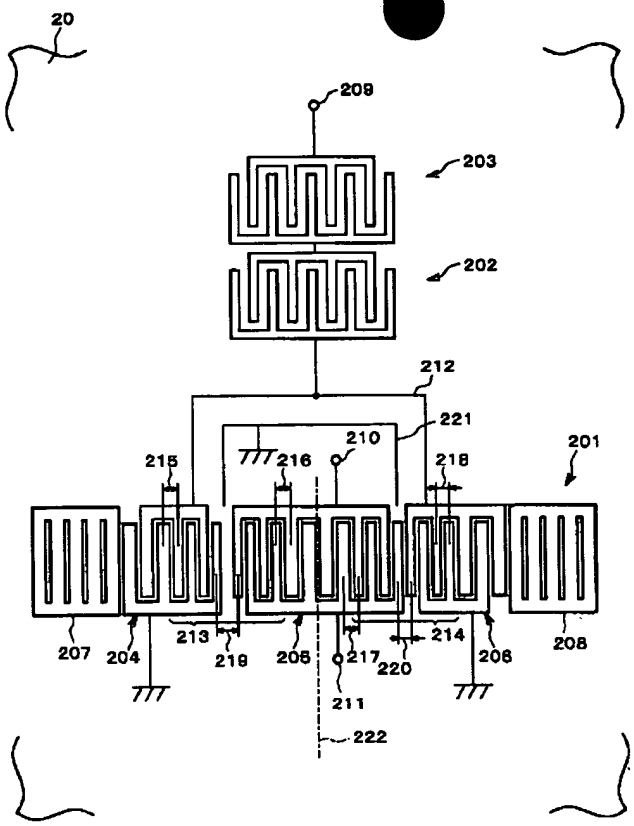
[Translation done.]

* NOTICES *

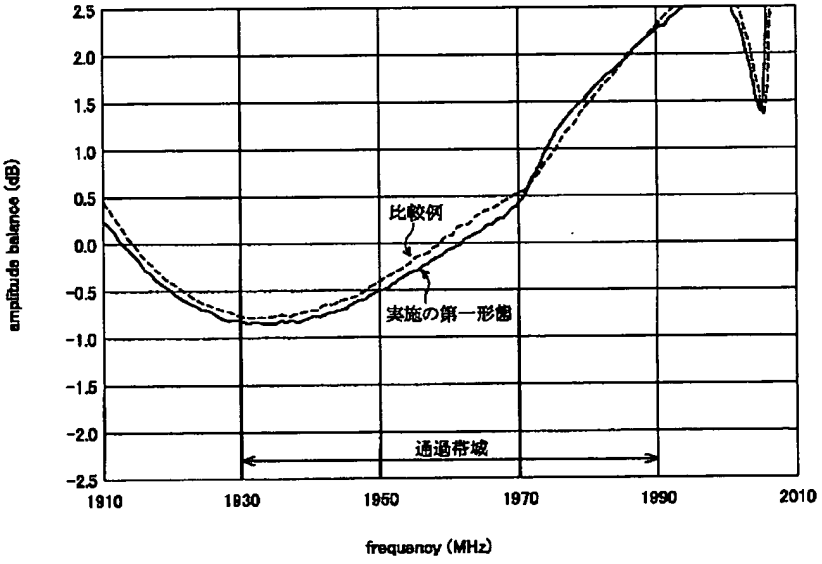
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

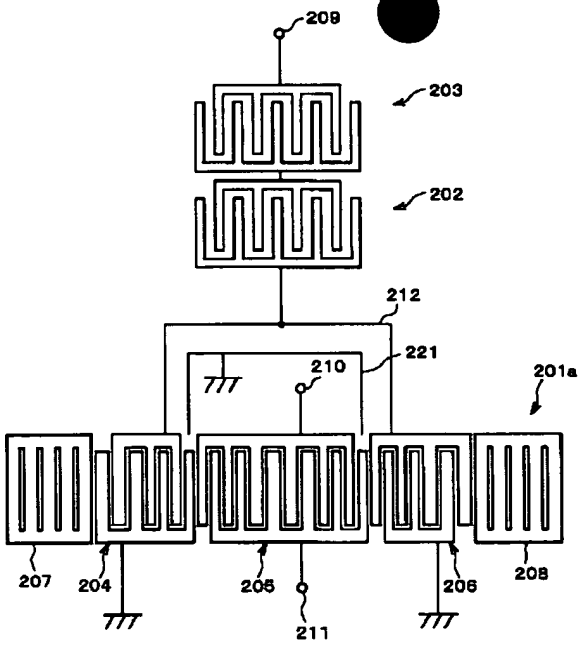
[Drawing 1]



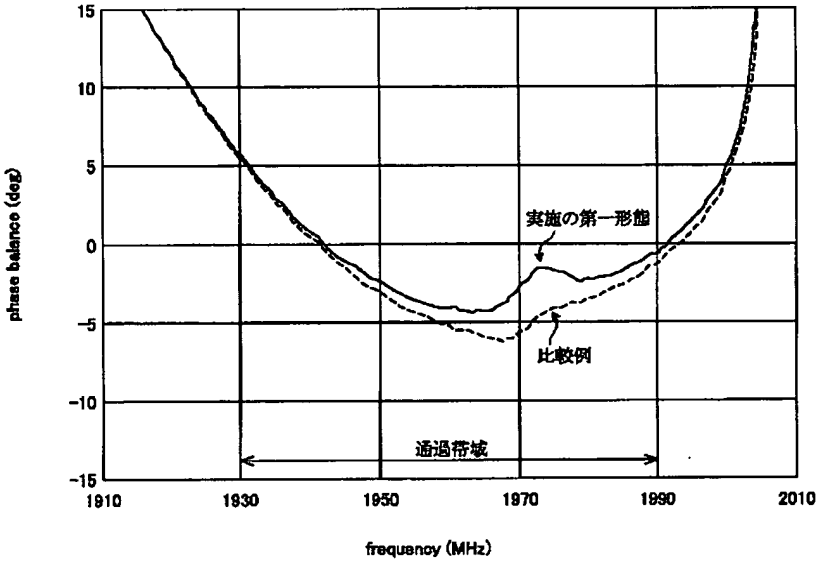
[Drawing 2]



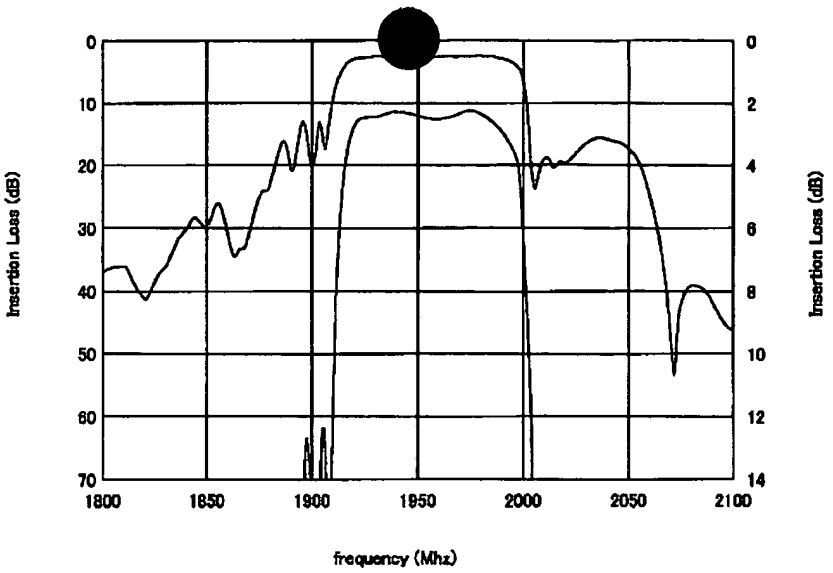
[Drawing 4]



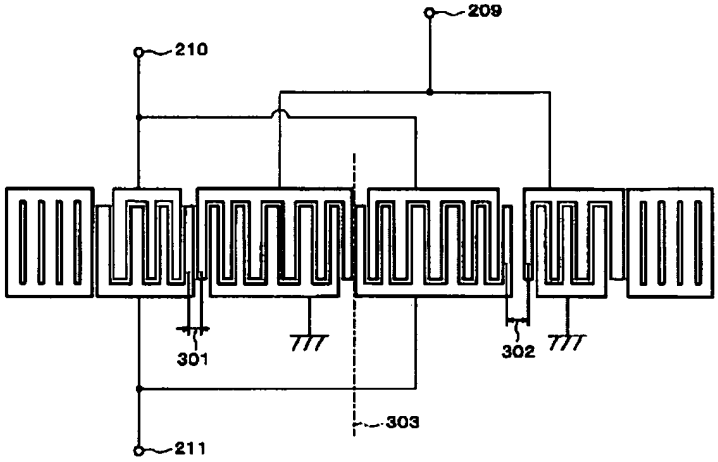
[Drawing 3]



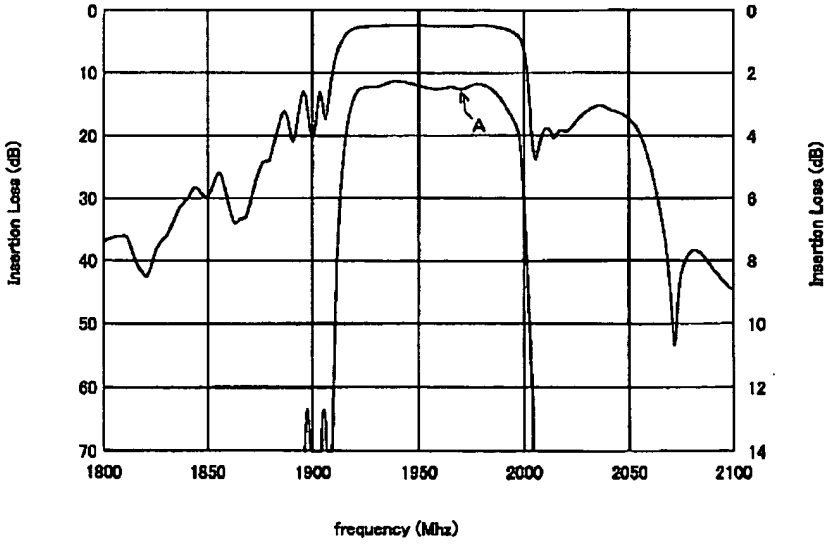
[Drawing 5]



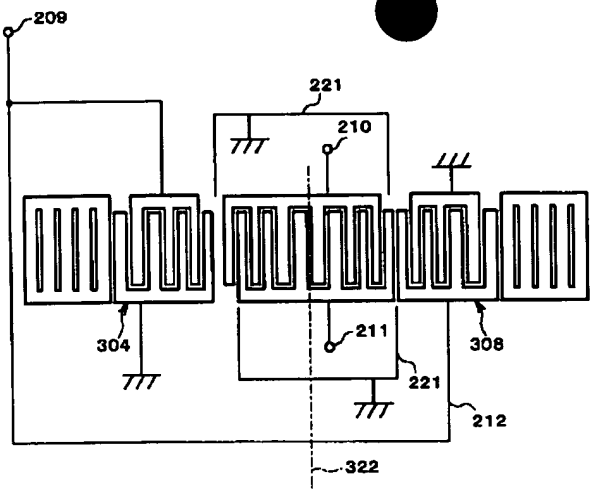
[Drawing 7]



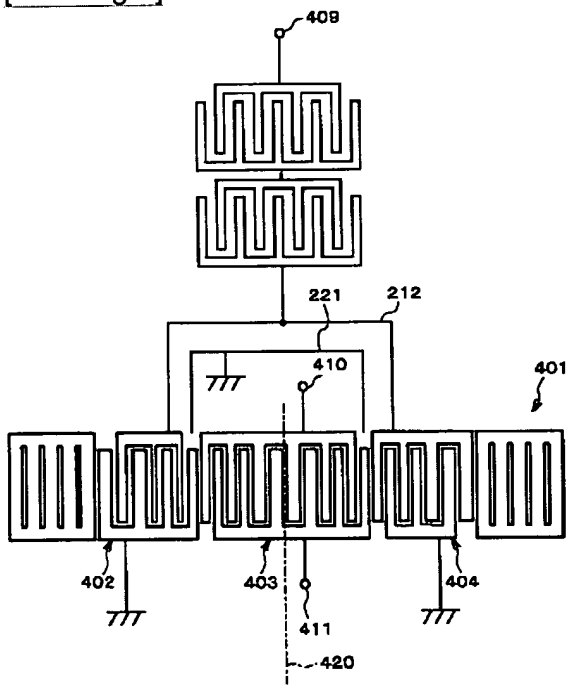
[Drawing 6]



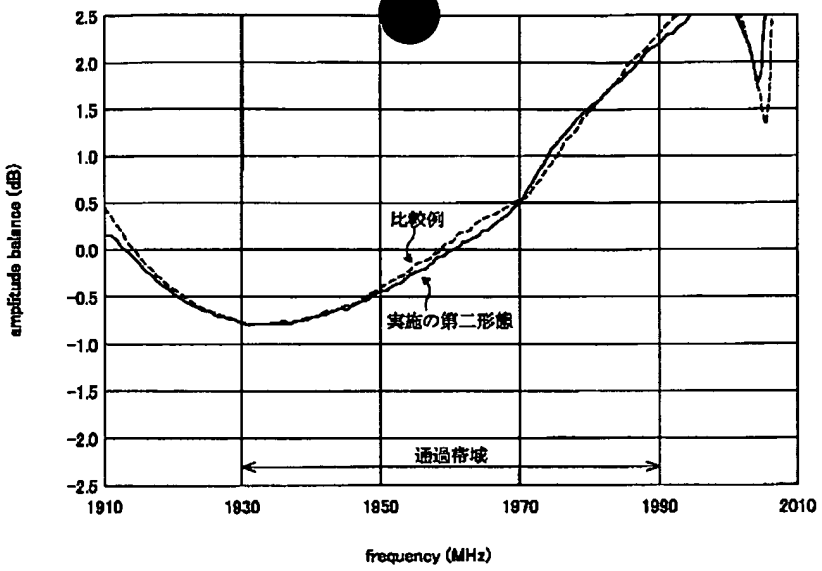
[Drawing 8]



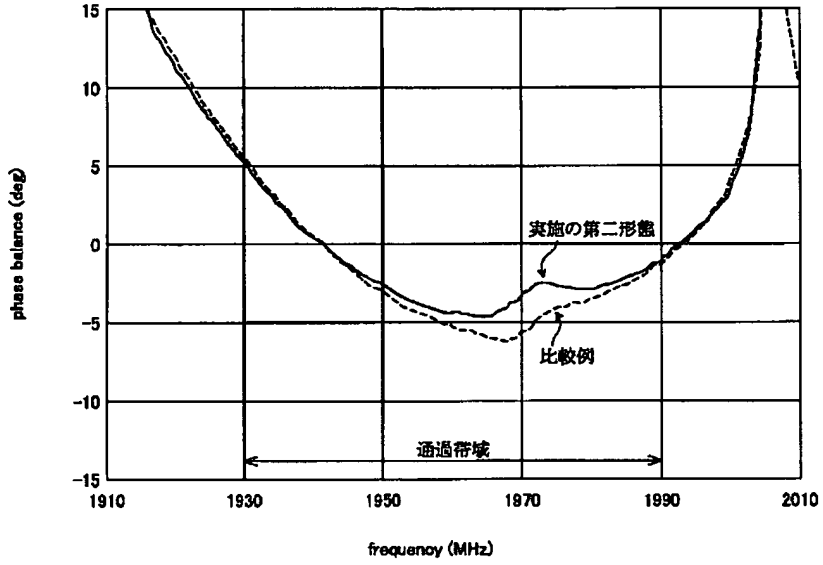
[Drawing 9]



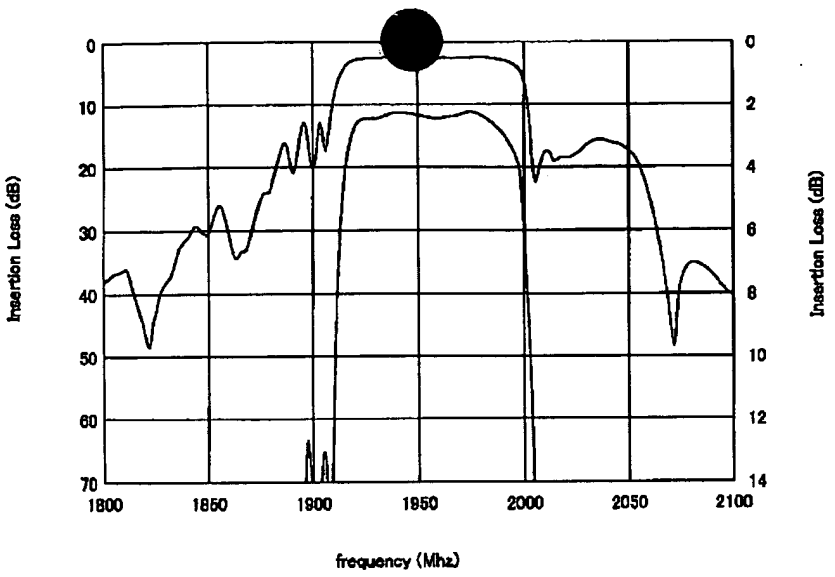
[Drawing 10]



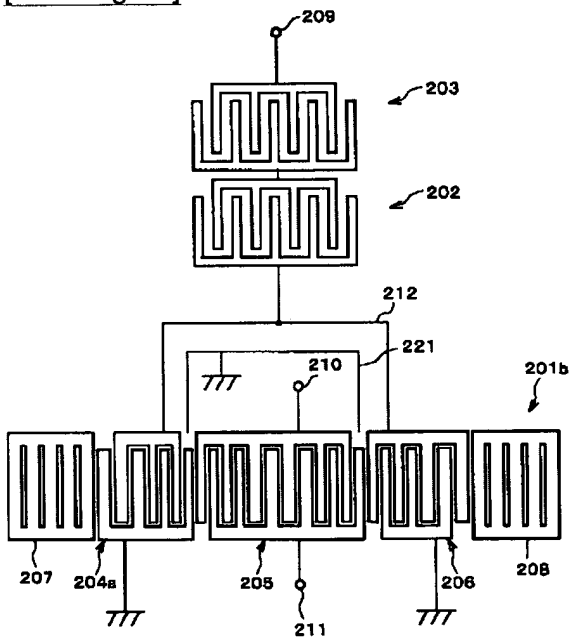
[Drawing 11]



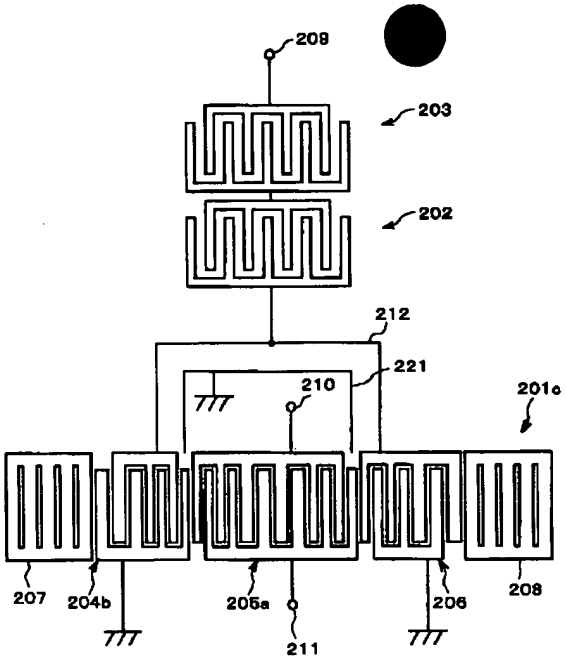
[Drawing 12]



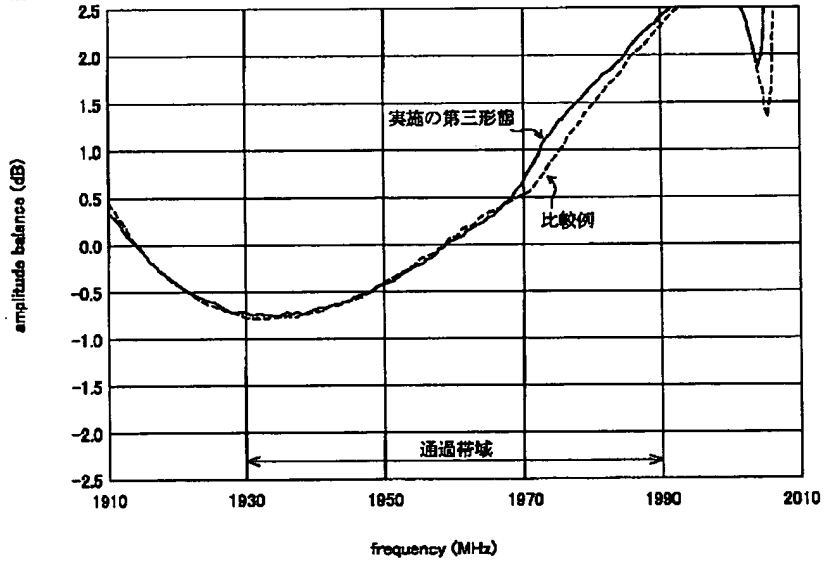
[Drawing 13]



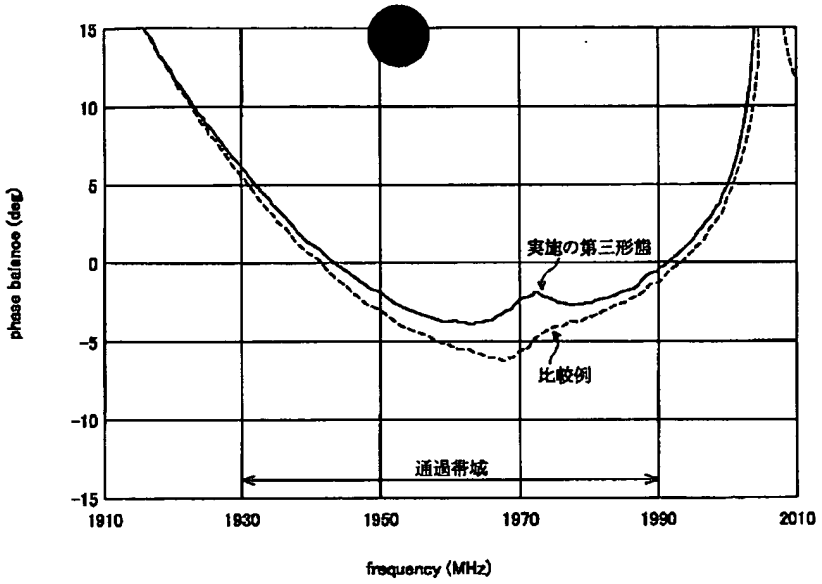
[Drawing 17]



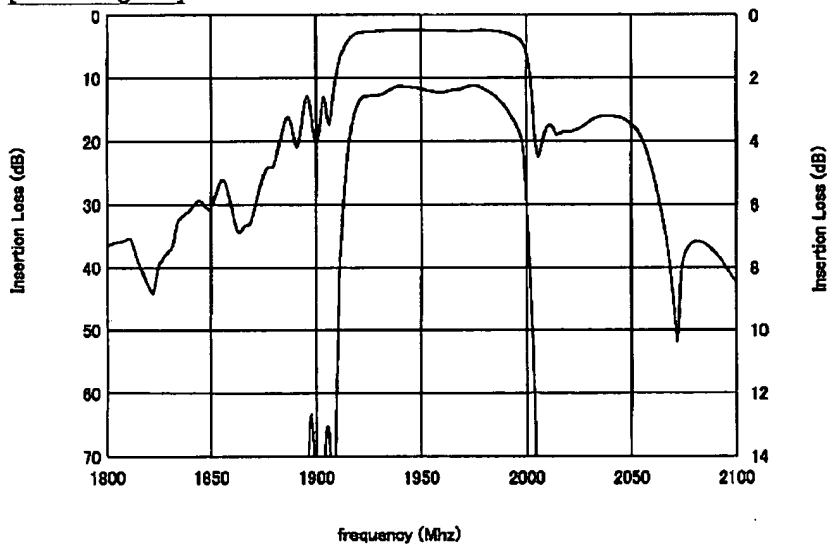
[Drawing 14]



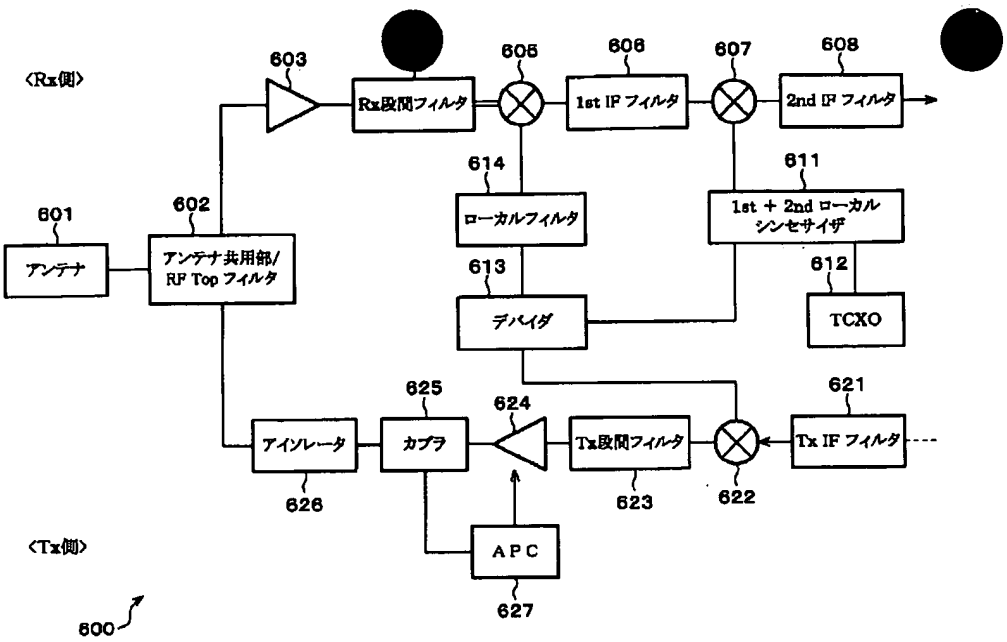
[Drawing 15]



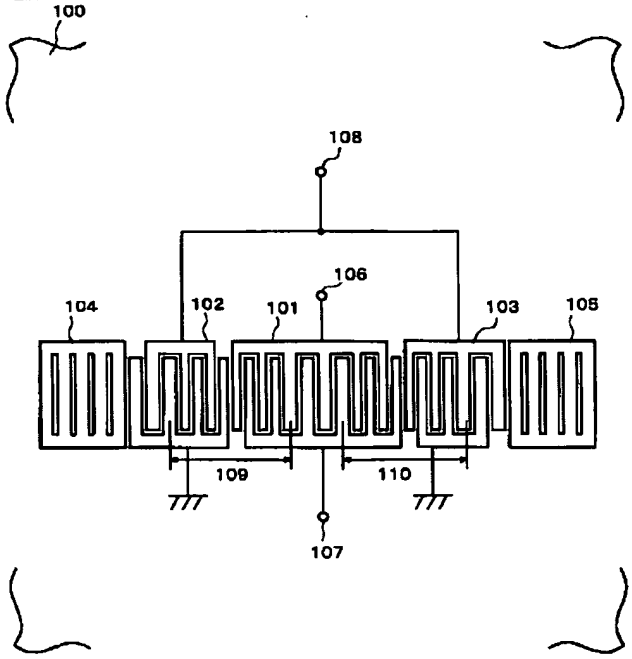
[Drawing 16]



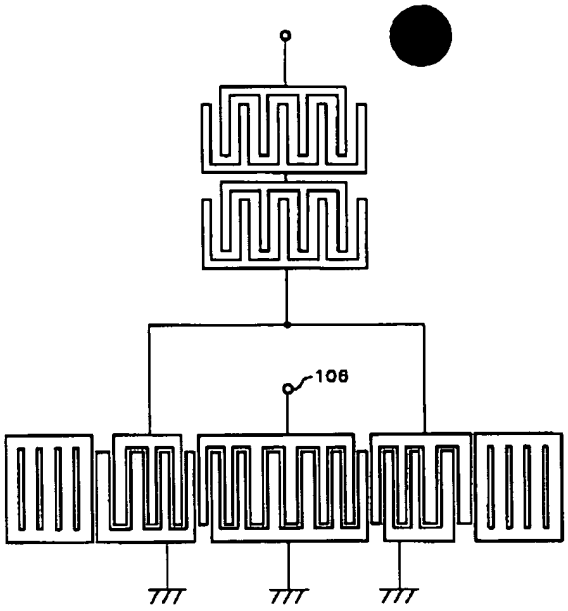
[Drawing 18]



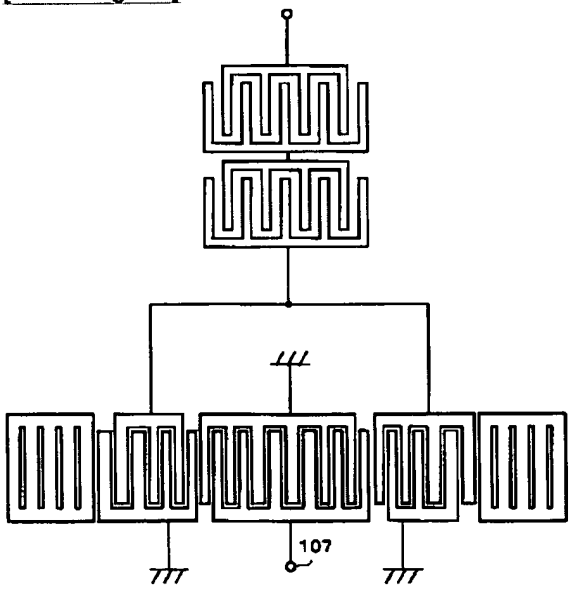
[Drawing 19]



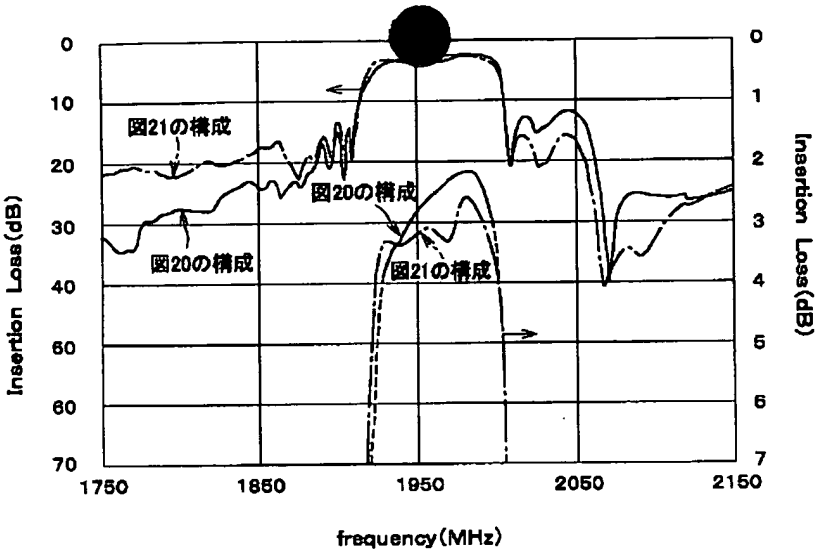
[Drawing 20]



[Drawing 21]



[Drawing 22]



[Translation done.]